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The Social and Cultural Context of Rural Water and Sanitation Projects: Case Studies from Ghana

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THE UNIVERSITY *of* EDINBURGH

A thesis submitted for the degree of Doctor of Philosophy

August 2012

Alison M. Furber: The Social and Cultural Context of Rural Water and Sanitation
Projects: Case Studies from Ghana, Doctor of Philosophy, © 2012

Declaration

I hereby declare that this thesis is my own work and effort. Where other sources of information have been used, they have been acknowledged. This work has not been submitted for any other degree or professional qualification.

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Abstract

The research underpinning this work took place in the context of two rural water and sanitation projects carried out in the Eastern Region of Ghana. The focus of study was on the way *engineers* can make water and sanitation projects more sustainable. In particular, emphasis was placed on the broad range of non-technical factors engineers need to incorporate into the design of water and sanitation systems and the processes they need to follow in order to achieve this, looking specifically at the implications of community participation for design process, project management and health and safety management.

The current high failure rate of rural water and sanitation projects provided the impetus for carrying out this work. There is an urgent need to improve engineering ability to provide vital life-saving infrastructure in developing countries as this infrastructure is a pre-requisite for poverty reduction.

A critical realist perspective framed the research to allow socially constructed realities to be combined with scientific and technical facts, and to allow inquiry in a 'real world' scenario where variables cannot be controlled individually. The research questions were explored through the author's involvement in two community development projects involving water and sanitation system implementation. The key methods employed were interview, both informal and group, observation and reflection.

The contribution to knowledge made by this investigation is an increased understanding of the relevance of social and cultural context for *engineers* engaged in rural water and sanitation infrastructure provision through exploration of these issues in a *particular context*. Also examined are health and safety aspects of rural

water and sanitation projects where the community participate in construction. Whilst health and safety had been explored in a developing country context there is a lack of previous work looking at these issues in a community self-construction context.

It was found that a broad range of factors need to be considered in the engineering design of water and sanitation systems if projects are to have a chance of being sustainable in the long term. In order to understand and design appropriately for the context of rural projects with direct community involvement it is necessary to adapt the engineering process to incorporate community participation fully into the design and construction of water and sanitation facilities. Where communities are involved in construction particular issues arise with regards to health and safety management; many of the issues originate in the socio-cultural context and motivations for community members to engage in hazardous construction activities need to be understood and considered to properly manage the construction process. To truly incorporate the ideas of local communities into engineering design, engineers need a greater awareness of the assumptions they hold arising from their scientific outlook.

Further research is required in different contexts in order to more clearly define the boundaries of the findings of this study and begin to overcome the limitations of the case study method. However, this research contributes to understanding how engineers can improve their designs of water and sanitation infrastructure and the processes they use to create more sustainable projects by looking at these issues in one particular context. This contribution adds to understanding of how a lack of access to water and sanitation infrastructure in rural regions of developing countries can be overcome, which is ultimately necessary to meet the Millennium Development Goals and as a pre-requisite to reducing poverty in the developing world.

Acknowledgements

I would like to thank my supervisor, Dr. Martin Crapper, for his continual support over the past eight years from the time I was an undergraduate student. I am so grateful for how encouragingly he has guided me through the past few years, and how calm and reassuring he has been during my moments of doubt and panic. I also wish to acknowledge my second supervisor, Prof. Paul Jowitt. His advice, recommendations and experience have been invaluable throughout.

I would also like to thank my co-authors for their contributions to the publications which have resulted from this work. Dr. Simon Smith guided me through my undergraduate studies and remains a much respected source of advice. Special thanks go to the soon to be Mrs. Sarah Campbell (nee Duncan) my co-author, proof-reader, and also my best friend. I could not have made it through the past few years without her and our weekly wine-time, which has undoubtedly kept me sane.

I am so grateful for having such a wonderful and supportive family. My father, Prof. Steve Furber, has made time to read drafts of my thesis despite having endless amounts of his own work to do. He is an invaluable source of wisdom on any topic. My mother, Mrs. Valerie Furber, whose kindness and generosity always touches me. I will miss our study days with extended pub lunches when we have both finished our respective degrees. My sister, Mrs. Catherine Cotton, has experienced so many changes in her own life over during the time I've been studying and now has a beautiful family. I am thankful to her for being a great friend.

All my friends have been amazing over the past few years. The future Mrs. Andrea Berry (nee Carter) has had to put up with living with me but has been a brilliant friend and always manages to say the right thing at the right time. Thanks to

everyone at Edinburgh University and Original Volunteers, it has been a pleasure sharing this journey with you.

The research was conducted with the aid of funds from The Royal Society of Edinburgh - John Moyes Lessells Travel Scholarship, The University of Edinburgh Small Grant Scheme and Engineers without Borders - UK Research, for which I also offer my thanks.

I am also grateful to the many people who contributed to the funding of the Emem Water Supply and Sanitation Project. In particular I wish to thank my Grandfather, Dr. Ben Furber, who gave a substantial donation to build the toilet block at Baw. The toilets will forever more be known as 'Ben's Bogs' in recognition of his generosity. I am indebted to so many friends and family who contributed money so kindly to the projects, without which neither the projects nor the research would have been possible.

Lastly, this research was only possible due to the warmth with which my many Ghanaian friends welcomed me into their communities and homes. I have learned so much from them. I am particularly thankful to Mr. Hope Setor, who despite being hired as a translator and boatman also worked tirelessly as labourer and chef or fulfilled any other role as needed. The projects would not have happened without him, he will be a friend for life. I also wish to extend thanks to the Chief and Elders of Emem and Baw, and to those at Emem who were involved in building me such a beautiful home.

I am so lucky to have met so many wonderful people during the last few years, I am truly grateful to everyone.

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1 Introduction

Globally, 1.1 billion people lack access to a clean source of drinking water; 2.6 billion lack access to basic sanitation facilities (UNDP, 2006). 1.8 million people die each year from diarrhoeal diseases with 88% of diarrhoeal deaths attributed to a lack of clean water, adequate hygiene and sanitation facilities (WHO, 2004). 90% of these deaths are children under 5 (ibid). These deaths are needless and could be prevented through the provision of safe drinking water and adequate sanitation facilities.

The situation is particularly severe in rural regions, especially in Sub-Saharan Africa where 50% of the rural population do not have reasonable access to an improved water source¹ and 75% do not have access to improved sanitation facilities² (World Bank data - 2008).

¹ Percentage access to an improved water source is defined as “the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, and rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 liters a person a day from a source within one kilometer of the dwelling” (World Health Organisation and United Nations Children’s Fund, Joint Measurement Programme definition).

² Percentage access to improved sanitation facilities is defined as, “the percentage of the population with at least adequate access to excreta disposal facilities that can effectively prevent human, animal, and insect contact with excreta. Improved facilities range from simple but protected pit latrines to flush toilets with a sewerage connection. To be effective, facilities must be correctly constructed and properly maintained” (World Health Organisation and United Nations Children’s Fund, Joint Measurement Programme definition).

1.1 *PROBLEM STATEMENT*

Engineers have a key role to play in poverty reduction through the provision of infrastructure in developing countries (Jowitt, 2006). The problem is not technical in its nature; the technology exists to provide those lacking these essential amenities with access to water and sanitation facilities. In rural areas the most appropriate solutions are often low-cost, low-tech technologies that can be made using locally available materials and can be operated and maintained by local people themselves (see for example WaterAid, n.d. (a)).

However, whilst solutions may be technically simple, effective and sustainable implementation of these technologies has proved to be anything but straight forward. Some studies estimate that 30% of all water and sanitation projects in Sub-Saharan Africa fail to be maintained in the long term (Global Water Challenge, 2011). Some studies conducted place local failure rates even higher; a study of the Menace region in Mali found 80% of wells were in disrepair and another study carried out in Northern Ghana found 58% of water points to be likewise (Skinner, 2009).

Other authors have colourfully illustrated some of the difficulties that occur in implementing water and sanitation projects. Box 1.1 contains an excerpt from Webster (2006) where he describes an unexpected outcome of a water and sanitation project he experienced during his work in Uganda. He attributed the variation in expected and actual outcome of water and sanitation projects to failures in inter-cultural communication.

Skinner (2009) highlights the importance of considering social aspects for the long term management and sustainability of water and sanitation projects, an excerpt from his work can be found in Box 1.2.

Why would a man continue to send his children to collect water from a spring 500 metres down a steep mountainside, an arduous two hour round-trip trek, when he had just heavily invested time, money and material resources in a concrete jar to collect rainwater from his roof? Whilst the rest of the community were successfully using their jars to meet their family's water needs, Byaruhanga's jar lay on its side. Along with two pieces of guttering, it remained unused. When asked why, he simply said, "I have children to collect water"

Box 1.1: Excerpt from Webster (2006)

Baptista (2010) warns of the dangers of not properly considering social structure and the impact that community development may have on it when planning water and sanitation infrastructure implementation. An excerpt from Baptista is found in Box 1.3. In the village of Canhane, Mozambique, a piped water system was constructed but due to technical limitations of the pump it was not possible to pump water all the way into the centre of the village. Instead water was pumped to the outskirts. Out of sight of the chief's house the community did not perceive this to be a communal facility available to all and overseen by the senior members of society. Therefore, members of the community did not feel they were able to make use of the advantages offered by this infrastructure (Baptista, 2010).

These examples illustrate that there is a wide range of factors that need to be considered to improve the long term sustainability of rural water and sanitation projects in developing countries. Incorporating technical and economic factors is not enough; there are many social and cultural aspects which impact on the implementation of technologies. Overlooking the importance of these aspects can lead to project failure and this leaves people without access to essential necessities of life, to which they have the basic human right.

In a village in Gotheye commune, Niger, the chief runs the borehole. This has two footpumps, installed around 20 years ago. One broke three years ago. A man appointed by the chief collects fees for water at the working pump. But the village women, who draw the water daily, say he does not systematically charge the chief's friends and family the standard rates.

During a village meeting the people said funds to replace the broken pump were insufficient. The women are frustrated by the chief's management and fear the second pump will break, forcing them to rely on river water. They are willing to pay, but lack the social influence to lead on managing the pump. Equally, during the first few years of pump operation, water was not sold, so there is no capital fund for renewal and maintenance. As a result, the chief has been publicly accused of embezzling part of the fund, and there is no clear process for recourse.

Like many villages in Africa, this one needs outside help if it is to restructure the internal rules and pricing policy of its 'water supply cooperative'. That way, a trickle of revenue can, collected over time, pay for repairs and pump renewal – the maintenance issues that are crucial to community wellbeing and development.

Box 1.2: Excerpt from Skinner (2009)

The question remains, what more can engineers do to increase the success rate and sustainability of rural water and sanitation projects?

What are the social and cultural factors that engineers need to be aware of when they design water and sanitation systems for rural communities? What processes should they follow to ensure infrastructure truly meets the needs of these communities? How can rural water and sanitation projects be managed and implemented to ensure the greatest chance of long term sustainability?

The Mozambican village of Canhane has been frequently cited as a successful case of 'community development'. This is the result of the implementation of a 'community-based' tourism venture, which began in 2004. However, this positive image hides conflicting social processes that have been caused by the emergence of 'untraditional' modes in the village... [N]ew perceptions of water and forms of its control, which were an outcome of the project's tourism 'benefits', are shaking up social relations in Canhane. With profound water shortages persisting in the village, its residents decided to invest revenue generated through tourism initiatives in a water supply system. Since its completion, however, the village has experienced apparently contradictory social upheaval. Although the water system is functioning, in practice it is not being used... [R]esponses [to 'tourism benefits' in Canhane] caused changes in customary practices of control over water.

Box 1.3: Excerpt from Baptista (2010)

1.2 THESIS

The thesis that will be argued throughout this work is that the social and cultural context of rural water and sanitation projects in developing countries impacts on all aspects of engineering design and process, and failure to adapt engineering designs and processes appropriately for the local context decreases the likelihood of the implemented systems being sustainable in the long term.

1.3 RESEARCH AIMS

Research is undertaken from an engineering perspective of development. The overarching aim of this research is to understand how engineers can increase the sustainability of rural water and sanitation infrastructure in developing countries by adapting their designs and processes for the local socio-cultural context.

A detailed list of research aims is presented below, broken down into the four main topics of the thesis.

Design Parameters

The research aims to:

- Identify design parameters which arise from the socio-cultural context at two case study projects;
- Consider the importance of including socio-cultural factors in engineering design to achieve project sustainability; and
- Consider the implications of findings for other engineers involved in water and sanitation provision in developing countries.

Design Process

The research aims to:

- Discuss the benefits and difficulties of the engagement methods trialled during one case study project as perceived by both the author and the community;
- Explore possible explanations for a number of engagement issues which occurred during the project; and
- Consider how engineers can adapt their design process to encourage a range of different groups within beneficiary communities to participate in the design of their systems.

Construction Management

The research aims to:

- Explore the socio-cultural causes of a number of construction management issues that occurred during two case study projects; and
- Consider how these types of issues could be avoided during other similar construction projects by adapting management strategy to the local socio-cultural context.

Health and Safety

The research aims to:

- Explore the implications of socio-cultural context for the motivation of community members to engage in hazardous construction activities during a case study project; and
- Consider the broader implications of this research for engineers engaged in water and sanitation projects in other regions.

1.4 SIGNIFICANCE OF THE PROBLEM

This problem is significant because of the millions of people who die due to a lack of adequate water and sanitation facilities. In addition to the direct health costs there are many indirect impacts. 443 million school days are lost worldwide from water-related illness, and the economic impact of a lack of water and sanitation facilities is estimated to be \$28.4 billion in Sub-Saharan Africa alone (UNDP, 2006). \$28.4 billion is 5% of the Gross Domestic Produce of Sub-Saharan Africa, a larger figure than the total amount of aid flowing into the region (ibid). There are currently 1.4 billion people living in extreme poverty³ (World Bank data - 2008); finding ways to provide these people with sustainable access to water and sanitation facilities is a prerequisite to finding solutions to poverty (Jowitt, 2006).

The economic means exist to solve the problems associated with a lack of water and sanitation facilities; the technology exists. Understanding how engineers can better design and deliver sustainable water and sanitation solutions that are socially and culturally appropriate, using democratic and participatory processes that protect the safety of those involved, are necessary steps to reducing the suffering of those who lack access to adequate water and sanitation systems.

³ In 2005 the World Bank defined those living on less than \$1.25 to be living in extreme poverty. Exchange rates are adjusted to account for inflation and purchasing power.

1.5 *STRUCTURE OF THESIS*

Chapter 2 provides background information on community centred approaches to development to explain the context within which research is set. This chapter sets the stage for the rest of the thesis; it introduces key concepts, which are integral components of the type of development approach being considered throughout the rest of the thesis. This chapter covers background literature relevant to all of the subsequent chapters. There is no single literature review as each results chapter also has its own literature section in which literature of more specific relevance to that chapter is discussed.

Chapter 3 explores the methodological framework within which research has been undertaken and gives details of the methods used.

Chapter 4 presents background information on Ghana and introduces the case study projects to which the subsequent results chapters refer.

Chapters 5, 6, 7 and 8 are the results chapters. Each chapter looks at the implications of socio-cultural context for a different aspect the engineers work when engaged in rural water and sanitation provision in developing countries. Chapter 5 focuses on design parameters that may arise from the socio-cultural context, whilst chapter 6 considers the design processes that are necessary to identify those design parameters. The discussion for chapters 7 and 8 turns to matters of construction management with chapter 7 discussing broader management issues associated with socio-cultural context and chapter 8 taking a more focused look at socio-cultural implications for health and safety management.

Chapter 9 presents the conclusions of the thesis.

1.6 CONTRIBUTION TO KNOWLEDGE

Ali (2009) identifies the need for engineers to understand social aspects and integrate them better into their work; “As the global need for infrastructure services is still unmet and standards are changing with time, engineers’ role will remain important in the future..... There is also an increasing demand on engineering practice to understand and integrate the social dimension into the planning, design and use of infrastructure. As members of multidisciplinary teams they are expected to work more closely with users and communities and in some cases learn from them, not only about their needs but also about the possible ways of facilitating what they want to achieve.”

Jowitt also calls for increased understanding of the interface between infrastructure and social and cultural concerns (2006, p19), “Whilst engineers must remain experts in their particular fields, they must also understand – and play an active part in – the interactions between infrastructure and development, the environment, culture/society/community, the economy and the political/public/private/third sector organisations involved”.

The need to undertake development work in a more culturally sensitive way is not only presenting a challenge for engineers. “The new emphasis on culture has far-reaching implications, and may constitute the greatest challenge to the rethinking of development” (Hettne, 2002 p10); “Development practitioners and development thinkers alike are puzzling over the implications of culture for the participation of beneficiaries, for the success of projects and how culture contributes to non-economic goals of development” (Radcliffe, 2006).

This research contributes to knowledge by increasing understanding of the relevance of social and cultural context *for engineers* engaged in rural water and sanitation infrastructure provision. Existing theories from development discourse

are tested in two *new contexts* through the case study projects and new data is collected and analysed at each of these projects. Finally, chapter 8 contributes to filling a gap in the construction management literature by exploring the implications of socio-cultural context for health and safety management during projects where an *unpaid* labour force work on construction projects to develop their own communities.

The following peer reviewed papers have been accepted for publication to date, with more publications planned for the future:

- Alison Furber, Sarah Duncan, Simon David Smith & Martin Crapper (2012): The health and safety implications of socio-cultural context for community construction projects in developing countries, Construction Management and Economics, DOI:10.1080/01446193.2012.707324
- Alison Furber & Martin Crapper (2011): Culture in rural water and sanitation projects: a case study, published in the proceedings of the 35th WEDC International Conference, Loughborough, UK
- Alison Furber, Simon David Smith & Martin Crapper (2012): A case study of the impact of cultural differences during a construction project in Ghana, to be presented at the 2012 conference of the Association of Researchers in Construction Management

2 Community Centred Approaches

This chapter provides background information on community centred approaches to development to explain the context within which research is set. The key concepts of bottom-up development approaches are presented following discussion of the decision to focus on this type of development strategy. It should be noted that many of the assertions made in this chapter reflect the author's own political opinions. The political views of the author are set out as the selection of bottom-up development approaches make sense when considered to arise from a particular ideological perspective. This chapter sets the stage for the rest of the thesis; it introduces concepts such as community participation, which are integral components of the type of development approach being considered throughout the rest of the thesis.

2.1 *POVERTY: A GLOBAL CHALLENGE*

"Humanity now faces its greatest challenges – addressing issues of climate change and sustainability on the one hand and poverty reduction and governance on the other" (Jowitt, 2006)

The metaphor of the earth as a spaceship with limited resources which must be shared amongst and between generations gained poignancy in 1970 when NASA published the first photograph of the earth as seen from the moon. "We travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil, all committed, for our safety, to its security and peace. Preserved from annihilation only by the care, the work and the love we give our fragile craft" (Stevenson, 1965).

There are now estimated to be seven billion passengers aboard spaceship earth (UN, 2011) and they are failing to share its resources equitably. The top 1% own 40% of the world assets whilst the bottom 50% are left to struggle with around only 1% (Davies et al., 2008); this leaves over 20% of the population of the world living below the poverty line on less than \$1.25 per day (World Bank data - 2008). One in every two children around the world live in poverty (Shah, 2010) and 21,000 children die each day (Shah, 2011); one out of every ten children born in Sub-Saharan Africa dies before the age of five (World Bank data - 2010).

The motivation for richer countries in the North to act on poverty in the South is more than just a moral obligation, as Moore (2002) notes, "Poverty in all its forms is the greatest single threat to peace, democracy, human rights and the environment". Clark (2005) goes on to say that, "In a rapidly integrating world, such conditions and their effects are not confined within national borders. International money launderers, slave traders, drug cartels and terrorist networks operate from poor countries with weak institutions". These issues are global issues; poverty, therefore, is a global challenge.

Poverty has been on the global agenda since the end of the World Wars. The UN was formed in 1945 and whilst its main goal was to prevent conflict, Article 1 of its Charter also states that one of the purposes of the UN is, "to achieve international co-operation in solving international problems of an economic, social, cultural, or humanitarian character...", which implies an aim of poverty reduction (Clark, 2005). In 1948 the Universal Declaration of Human Rights acknowledged the right of every person to, "a standard of living adequate for the health and wellbeing of himself and his family".

The current political attack on poverty takes the form of the Millennium Development Goals. Box 2.1 shows the eight Millennium Development Goals.

There are eight Millennium Development Goals and all of the members of the United Nations have signed up to achieve the goals by 2015. The goals are designed to be the means through which to implement the Millennium Declaration of the United Nations' which was based on the values of freedom, equality, solidarity, tolerance, respect for nature, and shared responsibility (UN General Assembly, 2000).

Goal 1: Eradicate extreme poverty and hunger

Goal 2: Achieve universal primary education

Goal 3: Promote gender equality and empower women

Goal 4: Reduce child mortality rates

Goal 5: Improve maternal health

Goal 6: Combat HIV/AIDS, malaria and other diseases

Goal 7: Ensure environmental sustainability

Goal 8: Develop a global partnership for development

Box 2.1: The Millennium Development Goals

2.2 THE ROLE OF ENGINEERING

"There will be no spectators as the future unfolds. But there are particular implications for civil engineers and the Institution of Civil Engineers. And not for the first time." (Jowitt, 2006)

As Calestous Juma points out, "engineering is about solving practical problems. It is about exploiting humankind's innate ingenuity to design and build innovative systems to meet peoples' needs" (Juma in Guthrie et al., 2008). "Throughout human history, engineering has driven the advance of civilization. From the metallurgists who ended the Stone Age to the ship builders who united the world's peoples through travel and trade; the past witnessed many marvels of engineering prowess"

(NAE, 2008). More recently the impact that good engineering can have and the benefits that it can bring society have been proven by Bazalgette through the additional 20 years life expectancy the people of London can enjoy following the installation of his sewerage system (Jowitt, 2006).

Millennium Development Goal 7, target C aims to reduce by half the number of people without sustainable access to safe drinking water and basic sanitation by 2015. Whilst this target directly identifies the importance of infrastructure as a goal of development, infrastructure is also indirectly related to many of the other MDGs. "In one way or another, all of the UN MDGs depend critically on the delivery – and the processes of delivery – of the underpinning infrastructure upon which civilisation depends" (Jowitt, 2006).

The economic return of a \$1 investment in water supply and sanitation systems is estimated to be \$3 to \$34, depending on a variety of factors including the cost of the technology implemented (Hutton & Haller, 2004). As outlined above, the water and sanitation deficit results in hundreds of millions of lost school days around the world and an overall economic cost in Sub-Saharan Africa greater than the total amount of aid flowing into the region (see section 1.3, Significance of the Problem). It is hard to see how the eradication of extreme poverty is achievable with such a high economic cost incurred each year due to a lack of basic infrastructure. The role of engineering in poverty reduction is critical.

In developing countries however, there are only five engineers for every ten thousand people, in some African countries there is less than one (UNESCO, 2010). It is estimated that two and a half million new engineers would be required in Sub-Saharan Africa if water and sanitation facility access is to reach everyone (ibid). Based on these statistics it is clear to see that there are not enough local engineers to undertake the work; support will be needed from abroad. Even if there were enough engineers in developing countries, those engineers could be as foreign to the

rural community as a Western engineer. There is no guarantee that an engineer with the same nationality as the rural community will share the same culture, values and perspective on life.

2.3 *RURAL POVERTY*

Currently more than half of the population of the world live in rural areas (IFAD, 2011); the 2007 Human Development Report estimated that amongst them were more than three quarters of those living on less than one dollar a day (Watkins, 2007). Whilst the total rural population is expected to peak between 2020 and 2025, rural poverty will continue to be a problem for the foreseeable future (IFAD, ob. cit).

Many of the development strategies that have been implemented since World War II have failed to bring benefits for the rural poor. Top-down neo-liberal development theories have led to approaches which aim to increase the economic income for countries as a whole. Increased inequality is a feature of this type of development and it is generally the better-off, urban populations who benefit (as demonstrated in China and India by Korzeniewicz and Moran, 2007). The only hope for the poor is that if the economy grows sufficiently, the small proportion of the benefits gained by the poor may be enough to lift some out of poverty. The mechanism of 'trickle-down' is relied upon for this, as the few 'winners' become richer they can invest in industry and thus create jobs and increase income for others who in turn have more income to spend on goods and services provided by others. Some interventions have had negative impacts for the rural poor, in particular harsh trade agreements that have been hypocritically enforced by developed countries in the name of free trade as part of a liberalist agenda.

These economic approaches are based on ideals of modernisation and industrialisation. Society must change from traditional agricultural forms of organisation and take on a more technological, urban form. Individuals in society

must think and act rationally in their own best economic interest. Traditional way of life and culture in this sense becomes a barrier to development. If the rural poor are to benefit they often must relocate to urban areas to take advantage of the employment opportunities this type of development offers.

Whilst still widely applied, these development approaches have received much criticism for the Eurocentric values which are implicit within them. Escobar (1995) describes how, "Development was—and continues to be for the most part—a top-down, ethnocentric, and technocratic approach".

Non-governmental Organisations (NGOs) have led the way in alternative forms of rural poverty alleviation. In the 1960s some NGOs began to develop new and innovative approaches to poverty reduction that work from the bottom-up. These 'grassroots' approaches have worked to help communities become empowered through community-led schemes and have provided the means by which the world's poor can find a voice. They have brought to the fore issues of participation and gender equality with a more decentralised, culturally sensitive and locally adapted approach to poverty reduction (Clark, 2005).

It was not until 1992 at the United Nations Conference on Environment and Development that grassroots approaches were supported on an international scale, endorsed in Agenda 21 (UN, 1993). "Development, for perhaps the first time in an international agreement, is seen as something built by people, rather than from the top down through large state projects" (Dresner, 2002)

2.4 CONCEPTS OF GRASS-ROOTS DEVELOPMENT

2.4.1 Sustainable Development

In 1983 Gro Harlem Brundtland led the World Commission on the Environment and Development which resulted in the publication of a report entitled, 'Our Common Future' (WCED, 1987). They set out a path for development which they called Sustainable Development, 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs' (ibid). Sustainable development incorporates social and environmental concerns along with economic considerations in development. This report aligned the goals of development with environmental concerns, where previously developing countries had seen environmental concerns as a luxury for richer countries (Dresner, 2002).

Sustainable development on a global scale is based on the idea that there are environmental limits (Meadows et al., 2004) that place restrictions on the possibility of continuous economic growth (Daly, 1977). In other words, it is not feasible for the world economy to grow indefinitely and through 'trickle down' mechanisms eliminate poverty and achieve a state of 'consumerism of the masses' (the goal of modernisation according to Rostow (1960)). Most agree that developing countries do need to develop economically but it is hoped that there may be a way to achieve this without the environmental and social destruction that is likely if the path taken by developed countries is followed. There is a moral imperative on developed countries to ensure that developing nations are not disadvantaged in their course of development, however. New cleaner technologies may have a role to play achieving this goal.

Sustainable approaches advocate more equitable distribution of wealth rather than boundless increases in wealth. Wilkinson and Pickett (2010) present a convincing

argument for the benefits that could be brought to society as a whole through increased equality. For them, consumerism, social isolation and unhappiness are direct results of inequality.

At the project level, sustainable development is about conducting projects in a way that preserves local social and environmental resources and ensures viability in the long term. With regards to water and sanitation projects, sustainability means ensuring communities have the means and ability to maintain their infrastructure in the long term and designing systems that are culturally and socially appropriate and truly meet the needs of the communities in which the projects are conducted.

2.4.2 Basic Needs and Rights Based Approaches

During the 1970s a development strategy arose from the International Labour Organisation division of the World Bank, at that time under the presidency of Robert McNamara, in recognition of the fact that macro-level economic development strategies did not go far enough to help the bottom 20% of the world. The goal of this type of development was meeting the basic needs of the poorest. McNamara funded projects which sought to develop rural areas of developing countries and engage the poor in the world economy (Clark, 2005). Smaller scale, riskier (for the Bank) projects were supported with the aim of including and directly benefiting the poor. Whilst as a slogan the concept of basic needs took hold, the late 1970s saw the rise of neo-liberal economic policy and the creation of a new International Economic Order and the concept lost its eminence (Hoadley, 1981).

In the mid 1990s attention returned to the needs of the poorest in the form of rights-based approaches (Hickey & Mitlin, 2009). Rights-based approaches to rural community development recognise the entitlement that all humans have to an adequate standard of living and accords responsibilities for fulfilling this entitlement accordingly. By empowering communities and increasing the capacity

of government institutions a rights-based approach promises to increase the sustainability of development projects by reducing dependency on external aid (Gneiting et al., 2009).

2.4.3 Community-Driven Development

Community-driven development approaches recognise the right to self-determination of the rural communities undergoing development activities. They aim to put people in charge of their own development, rather than seeing communities as recipients of aid. Community-driven development aims to allow communities to identify their own needs and have increased control over the projects that are undertaken (Mansuri & Rao, 2004). Participation in projects is the process through which communities are able to drive development.

2.4.4 Participation

Participation is an umbrella term used for a wide range of processes which encourage the engagement of communities in development activities. It is a concept that has gained widespread acceptance following recognition that failure to involve local communities in development projects is one of the key causes of project failure (van Heck, 2003).

There are a variety of forms of participation that can be classified according to the power that is transferred from the development agency to the community (for example Arnstein, 1969). At one end of the scale little power is transferred to the community and participation is little more than 'manipulation' to bring the community on board with decisions that have already been taken; at the other extreme communities gain decision-making powers about the course of development projects. Consultatory approaches fit in-between these two extremes (ibid).

Methods of participatory appraisal have been developed to allow communities to identify their own development needs. Robert Chambers is an important proponent of this approach and, based on the work of Paulo Freire (Freire, 1970), developed processes for rural appraisal (Chambers, 1997). His rapid rural appraisal approach provides tools, for example social mapping, focus groups and visioning, through which practitioners can engage communities.

2.4.5 Empowerment

Empowerment is a, “multi-dimensional social process that helps people gain control over their own lives... [a] process that fosters power in people for use in their own lives, their communities and in their society by acting on issues which they define as important” (Page & Czuba, 1999).

Of relevance to rural water and sanitation projects are the power differentials that exist both between different groups within communities and between communities and other stakeholders, such as engineers. Participation in water and sanitation projects can allow communities to take more control over their own development but it is also important to consider which groups within the community are able to participate, who is marginalised and who is ultimately making decisions (Labonne & Chase, 2009).

2.4.6 Culture

Following criticism of neo-liberal development by post-development theorists, the importance of culture and its relevance to successful development interventions has gained widespread recognition (Rao and Walton, 2004). Modernisation theories, as epitomized by Rostow (1960), view industrialisation and urbanisation as critical aspects of economic development. Implicit in this Eurocentric perspective is the

idea that culture and tradition are barriers to development. As Escobar (1991) notes, “‘Culture’ – which until the 1970s was purely a residual category, since ‘traditional’ societies were thought to be in the process of becoming ‘modern’ through development – has become inherently problematic in development”.

Worsley (1999) identifies particular concepts of development as having cultural meaning and therefore not necessarily being universally applicable. ‘Profit’ is one example of a concept with cultural connotations that are not often openly acknowledged when used in development discourse (ibid). Ethnodevelopment is concerned with approaching development in a more culturally sensitive and locally orientated way.

The relevance of culture for rural water and sanitation projects is the implication that it is not always possible to replicate a successful intervention that took place in the context of one culture in another without considering the specific cultural heritage and social characteristics of the new context (van Nieuwkoop and Uquillas, 2000). Overlooking cultural factors is an important cause of rural water and sanitation project failure (Webster, 2006).

2.4.7 Local Knowledges

“What is signally absent in most public discussion of development are the ways in which the knowledges of the peoples being developed are ignored or treated as mere obstacles to rational progress” (Hobart, 1993, p2). Often local knowledges are blamed when development projects fail (ibid).

Local knowledge is relevant to rural water and sanitation projects in two key ways. Firstly, as water and sanitation projects often involve the introduction of new technology into a community which they will need to maintain in the long term, it may be necessary to consider existing knowledge as communities are trained in the

use of their new systems. UNESCO-IHE (no date) found this in their training of water and sanitation staff in Nepal and although they were training staff it seems equally as relevant if training is to occur at a community level.

Secondly, local knowledge can provide a useful source of information, especially with regards to local environments (Hobart, ob cit).

2.4.8 Feminist Theory, Gender and Inclusion

A further criticism of modernisation and neo-liberal development theory is that it fails to acknowledge and manage the unequal way in which this type of approach impacts on different groups within society (Boserup, 1970). Women are often disadvantaged when it comes to development due to the economic constraints imposed upon them, such as an inability to go out to work due to the family demands (ibid), and the lack of voice they can experience within both the family and society (Cornwall, 2003).

Gender approaches aim to impact on the lives of women in either a practical or a strategic way (Moser, 1993). Practical approaches aim to help women cope with their gender roles as they exist whereas strategic approaches aim to implement changes to gender roles (ibid).

Access to water and sanitation facilities are practical concerns for women in their existing gender role. It is often the women and children who must collect water and therefore when there is no water nearby it is they who must walk further to provide for the family (FAO, no date). The opportunity for girls to gain an education is also affected by a lack of water and sanitation facilities. Boys' education is often prioritised above that of girls and therefore where domestic duties, such as collecting water, are very time-consuming, girls are more likely to be pulled out of school to help with the daily chores of the household (Fisher, 2004). Where there are

no toilets, girls are more likely to drop out of school when they reach puberty (for example see Nkhonjera, 2011).

“It is now recognised that the exclusion of women from the planning of water supply and sanitation schemes is a major cause of their high rate of failure” (FAO, ob. Cit.)

2.4.9 Appropriate Technology

Macro-level development with a focus on economic growth is often associated with large scale engineering technology aimed at increasing the overall GDP of developing countries. Within the water and sanitation sector this might include centralised water treatment facilities that provide piped water and sewage systems. The problem with this approach is that some within society are excluded from the benefits that this type of technology brings. The poor are excluded if they cannot afford to pay for services and those living in rural areas, likewise if they live outside the area covered by services.

Appropriate technology philosophy offers an alternative approach. Ernst Friedrich Schumacher first published, ‘Small is Beautiful: a study of economics as if people mattered’ in 1973, a book which was seminal in the appropriate technology movement. The book contains several insights which are still relevant today. Of particular interest here is his advocacy of small scale, decentralised technology that can be understood and managed at the community or household level, and which allows the community or household to become empowered through their own self-reliance.

Many of the technologies routinely implemented in rural water and sanitation projects can be considered ‘appropriate technologies’ including rainwater

harvesting systems, groundwater hand pumps, ceramic pot filtration, ventilated improved pit latrines and ecosan latrines, to name a few.

“Because of the inevitable financial constraints faced by developing countries, the emphasis tends to be on 'simple' solutions - practical, affordable, low-tech. However, 'simple' is a highly misleading description. Considerable creativity and innovation may be needed to develop solutions that work while taking into account environmental conditions, local materials and skills, manufacturing capacity, and constraints on installation and maintenance. As well as the technical challenges, there is the need to engage with people, their community and political representatives, and local academic structures” (Cairncross in Guthrie et. al., 2008, p. 21). Engineering for the developing world is not an easy option, a simplification of what works in the industrialised countries, but a distinct intellectual and practical challenge.” (Juma in Guthrie et. al., 2008)

3 Methodological Approach

The thesis set out in chapter 1 included the assertion that the social and cultural context of rural water and sanitation projects has implications for engineering design and process. Engineers typically hold a scientific world view and research would therefore usually follow the scientific method. This chapter presents an argument for the use of critical realism as the most appropriate framework to be applied to the research problem. It then goes on to describe the research approach taken before proceeding to discuss the advantages and limitations of the chosen approach. The chapter ends by considering some of the ethical dimensions of the methodological approach.

3.1 *RATIONALE*

It is important to be transparent about the philosophical basis upon which research has been designed. Underlying every piece of research are assumptions about the nature of reality (ontological assumptions), corresponding assumptions about the properties that knowledge should have (epistemological assumptions), and therefore which set of theories and concepts can be appropriately applied (methodologies).

3.1.1 **Ontological Perspectives**

Moses and Knutsen (2007) separate the myriad of viewpoints into two main camps, though acknowledge that a range of stances in-between are also possible (of which Critical Realism is one). On the one hand there is Naturalism, the traditional scientific approach, which views reality as distinct from our experience of it. “There exist regularities and patterns in nature that can be observed and described” (ibid).

The opposite view however, asserts that, “Patterns of interest are not firmly rooted in nature but are a product of our own making”; “Each of us sees things differently, and what we see is a complex mix of social and contextual influences and/or pre-suppositions” (ibid). This ideology is referred to as constructivism, as it holds the ontological position that reality is constructed by our experience of it; the role that humans play in interpreting their environment is acknowledged as an important aspect of our understanding of reality.

Reading the above brief descriptions of the two extreme understandings of reality it is apparent that the ontological approach chosen for a research project will be highly dependent upon the nature of the particular research to be undertaken. For example, if a researcher wants to explore the causal link between open defecation rates and diarrhoeal disease rates then a naturalist approach may be appropriate as the reality explored is independent of human perception of it. On the other hand, if the researcher is interested in the cultural perceptions of different toilet types then a constructivist approach is likely to be more appropriate as the reality is constructed by humans and it is their interpretation of that reality that makes the subject of inquiry.

3.1.2 Water and Sanitation Infrastructure Projects

This research is interested in the multifaceted nature of water and sanitation infrastructure projects. It strives to understand how socially constructed - social and cultural - aspects of water and sanitation projects can be incorporated with the scientific - economic, environmental and technical - ‘facts’ of water and sanitation projects.

In other words, this research needs to be based on a paradigm which is able to recognise that some realities are best represented through a naturalist ideology and some through a constructionist methodology. The research is based on the premise

that it is the successful combining of these various components that will lead to the eventual improvement of the service that engineers can provide to rural communities.

The framework which seems to best fit is that of 'critical realism'. Critical realism amalgamates the ontological positions of naturalism and constructivism by accepting the existence of realities which are autonomous of our observation of them, whilst recognising human agency and the meanings that humans can attribute to reality. The ontological position held by critical realists is that there is a reality that exists independently from human conception of it, but it is buried below layers of socially constructed understanding of reality (Bhaskar, 1978). A critical realist perspective identifies the complex nature of reality and the different realities that different questions seek to explore.

3.1.3 Epistemology and Methodology

The ontological position that reality is buried below layers of socially constructed meaning has direct implications for the epistemological position (Bhaskar 1978). Critical realism accepts both the internal mental realities of humans and the objective realities of nature and therefore there is a corresponding epistemological dualism. In other words the properties of the knowledge in question will be dependent upon the category of the reality explored.

The same is true of the methodology of critical realism. "Compared to positivism (naturalism) and interpretivism (constructivism), critical realism endorses or is compatible with a relatively wide range of research methods, but it implies that the particular choices should depend on the nature of the object of study and what one wants to learn about it" (Moses and Knutsen, 2007).

Essentially the application of critical realism allows the combined use of quantitative and qualitative methods, and accepts both forms of data as they correspond to their respective methods. From an engineering perspective this means a move away from the employment of purely quantitative methods and towards recognition of the strengths of qualitative methods. The inclusion of qualitative descriptions will allow for a depth and detail of understanding that is simply not possible when only quantitative data is considered. As Sayer points out, “Meaning has to be understood, it cannot be measured or counted, and hence there is always an interpretative or hermeneutic element in social science” (Sayer, 2000, P17).

Returning to the example of open defecation, establishing the causal link between open defecation and diarrhoeal disease lends itself to quantitative, statistical inquiry. On the other hand, understanding communities cultural perceptions of different toilet types could be achieved by qualitative methods such as interview. Critical realism allows both these lines of inquiry to be followed and incorporated into the same framework, without causing any philosophical inconsistency. Both lines of inquiry are relevant for finding solutions to the high rates of diarrhoeal disease.

3.2 APPROACH

Having set out the rationale for the use of critical realism to frame the research, this section moves on to look in more detail at the approach that will be taken. A number of different elements of the research approach are discussed including the use of action research through case studies of water and sanitation projects, particular issues that were anticipated arising from the context in which research was to be conducted, the use of reflexivity in engineering research, and the use of existing theories and models of culture.

3.2.1 Action Research

Research took the form of two case studies of water and sanitation projects that took place in 2010 in the Eastern Region of Ghana. Full details of the case study communities can be found in Chapter 4 of this thesis. Research took place throughout the projects and the research and projects were closely related. Research findings fed directly into the projects with the goal of improving the outcome for the participating community; the projects formed the basis of research. In this sense, the research can be considered Action Research (Lewin, 1946).

Incorporating 'action' into the research agenda ensures research remains highly relevant to real life problems. Learning by doing provides a platform on which ideas are both created and tested in an authentic setting. The actions that can occur from the research negate the frustration that could arise within communities where research raises awareness without opportunity for change.

3.2.2 Key Issues of the Research Context

Using a case study approach leads to several issues which need to be considered. Many of the issues discussed here stem from the fact that the case studies will be undertaken in an international context, with researcher and researched belonging to different cultures and accordingly holding different ideas which shape their respective behaviour and customs. The need to consider the cultural implications on the research methodology is all the more imperative due to the goal of the research to incorporate qualitative investigations of socially constructed realities into the research process and assimilate understanding of these social processes with more socially independent realities. The first issues which will be considered is language and meaning.

Language and Meaning

A fundamental concern of the research is how to manage the risk of misunderstanding that arises from working with communities who do not have English as a first language, as a researcher who only speaks English. This is a concern even where members of the community can speak English as a second language as it is possible that the meaning conveyed by the use of a particular word or phrase is construed differently by speaker and listener. The problem is rooted in the different definitions of central concepts held by researcher and researched and the misinterpretation that can ensue.

Where researcher and participant are unable to converse in a common language it is necessary to communicate through a translator. This raises the question of whether the translator is to provide a literal translation of words or whether it is more appropriate for him/her to try and purvey meaning. On the one hand, a literal translation can result in a loss or transformation of meaning. The need to translate each statement can disrupt the natural flow of conversation and present a barrier to free and easy communication.

On the other hand, encouraging translators to reconfigure language results in the researcher receiving information second hand; data has essentially already undergone a degree of interpretation. This approach places a high degree of confidence in the ability of the translator to understand the meanings of language in both contexts and be able to find equivalent terminologies. It risks the translator's biases and assumptions leaching into the data, without any measure or control over the process. Importantly, the translator may not have the awareness, training and/or desire to pass meaning accurately and reflect on the impact their presence has on the research findings.

The problem is exacerbated by the fact that in many instances it may be difficult if not impossible to tell the degree of modification occurring to the dialogue prior to receiving the communication.

The approach favoured by this research is to limit as far as possible the interpretation occurring at the stage of translation by the translator. This is achieved by clear expression of the translator's role to the translator. The translator is asked to undertake literal translation but is asked to flag up terms which are problematic to translate with meaning. The translator, researcher and participants maintain an awareness of the possible hazard of misinterpretation and double check meanings where misunderstandings have been sensed to occur. Throughout the communication, critical terms are actively identified and defined to ensure mutual understanding and to minimise ambiguity as far as possible.

It should be noted that there is a compromise to be made regarding the distance of the translator to the community participating in the research. A translator close to the research community is likely to have a very deep understanding of the meanings of language used by the community. However, some distance may be required to recognise them.

The personality of the translator, the type of words they choose to use and their general manner and demeanour, is likely to impact greatly upon how the conversation is perceived by both the researcher and participants. Equally this will impact on the type of information that participants are prepared to share with the researcher and the general tone of the conversation. This is all the more consequential when the research is seeking a contribution from the participant on more sensitive topics of conversation.

It is not only the personality of the translator that will be a factor for reflection. The sex, ethnicity, wealth and age amongst others will all play their part in determining

the tone of conversations, the participant's willingness to disclose and ultimately the nature of the data collected. This leads onto the next key issue for discussion, researcher (and translator) position, personality and power.

Researcher Position and Personality

The significance of positioning and personality to research processes are likely to be dependent upon a number of factors, for example: whether the data which is sought is considered to exist within the participants (the research method is then used as a tool with which to mine the data) or whether the data is considered to be constructed through the process of the research encounter; the degree of neutrality assumed attainable by the researcher; and whether or not participants are attributed with qualities such as agency. The relevance of positioning and personality can also be seen as an ethical concern, impacting on the overall positive or negative experience that participants take away from the research.

As discussed above, this research aims to explore a variety of realities and straddles the ontological position of naturalism and constructivism, selecting the 'best-fit' paradigm for the reality being examined. Therefore, the implications of positioning and personality will vary over the research context. For example, when researcher investigates more sensitive issues such as local perceptions of the practice of open defecation, researcher position and personality are a key consideration in the research planning and analysis. Conversely, when some of the more technical aspects of water and sanitation technology choice are explored, such as ground water levels or number of members of a household, positioning and personality are likely to play a much less predominant role.

That said however, it should be noted that positioning and personality can play a vital role in obtaining even the most factual data. Local communities have the ability to share and withhold information from visiting researchers as they like. If

the intentions of the researcher are unknown or not understood by local communities, it is possible that they could choose not to co-operate with research.

The implications that a particular researcher position and personality has on research is incredibly complex and equally depended on the position and personality of the participants. Implications can range from: access to particular communities or members within the communities; the community activities the researcher is party to and able to observe; to the openness of participants and the types of information they are prepared to share with the researcher, for example.

Power

Closely linked to ideas of position is the concept of power. The complex power dynamics at play in the research context will have many implications on research methodology. The power differentials are an important consideration at the stage of ensuring informed consent from the participant. For example, if the researcher is much more powerful than the participant then the participant may feel obliged to consent to participate. Equally, when working with rural communities, if a chief has asked a villager to take part in the research process then the villager will accommodate this request but the consent process has to all intents and purposes been undermined.

Power differentials can also significantly impact on the information shared by participants. A powerful researcher may compel participants to provide the answers they anticipate the researcher wants. Participants may come under pressure from others within their community to express an opinion that is not their own. For example, an engineer carrying out a survey to ask a community where they would like a well positioned may be greeted with the unanimous response that the well should be placed outside the chief's house. It is conceivable that the power structures that exist within their community necessitate consideration of the chief's comforts above their own.

3.2.3 Reflexivity

In the last section, some of the issues of working in an international context were highlighted. Many of the matters discussed are more than just a practical concern affecting logistics such as access to the field. They also have significant implications on the nature of the data that is collected, the information shared and the ways responses are structured and construed. As such it is necessary to make transparent those inherent biases and subjective interactions that occur in real world research. Reflexivity is the means by which this is hoped to be achieved.

“Reflexivity, broadly defined, means a turning back on oneself, a process of self-reference. In the context of social research, reflexivity at its most immediately obvious level refers to the way in which the products of research are affected by the personnel and process of doing research” (Davies, 1999 p.4)

All that said there are some apparent difficulties to the use of reflexive practice. One of the dangers of becoming overly reflexive is that the researcher becomes self absorbed and indulgent in their presence in their research work. It is easy to become fixated on researcher position and lose site of the bigger picture of the research aims. A compromise is required to find balance between making transparent the researcher’s own involvement and focusing on the tangible research findings as relevant to the research context being considered.

Keeping a reflexive diary during the fieldwork can help to identify those occasions on which matters of position and power have affected the responses imparted by participants. Building in processes by which to reflect on research in a timely manner is essential if the intricacies of social relationships are to be remembered and incorporated into research analysis.

3.2.4 Frameworks for Understanding Culture

Much of the discussion in subsequent chapters is concerned with the implications of culture for the work of engineers. Culture is a somewhat nebulous concept that has been defined in numerous ways by a variety of authors (see for example Kroeber and Kluckhohn 1952). For the purposes of this thesis, culture is defined as, “the cumulative deposit of knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and material objects and possessions acquired by a group of people in the course of generations through individual and group striving” (Samovar and Porter, 1994).

A number of frameworks for researching culture already exist. Ogbor (1990) classed approaches to studying the implications of culture into three categories, approaches concerned with looking at the patterns of meaning (Geertz, 1973), cultural paradigms (Schein, 1985), and cultural dimensions (Hofstede, 1980, 1991; Hofstede et al., 2010).

The most influential framework is probably Hofstede’s six dimensional model and this is the primary model of culture utilised for this research. This choice was made for pragmatic reasons as Hofstede’s theory provides an accessible and useful means by which to get a handle on the complexities of studying culture. In addition, an initial reading of Hofstede’s work rang true to the author’s sensibilities and seemed to elucidate meaning in some of the events that occurred during the case study projects. The overlap between Hofstede’s theories and those of others is discussed in the ‘Other Theories’ section below. It is accepted that other models of culture might equally have been used.

Hofstede's Dimensions of Culture

Hofstede statistically analysed over 100,000 questionnaires which measured the values of employees at IBM in over 50 countries. In the original version of his model four independent dimensions were identified that could be used to characterise cultures on a national scale (Hofstede, 1980). The fifth and sixth dimensions were added later in 1991 and 2010 respectively (Hofstede, 1991; Hofstede et al. 2010). Hofstede himself notes that the cultural dimensions do not exist per se; they are in fact useful constructs. "A construct is a product of our imagination, supposed to help our understanding. Constructs do not "exist" in an absolute sense: We define them into existence" (Hofstede, 1980: Ch.1, p14).

Hofstede has been criticised for making generalisations about cultures but his work is unarguably useful for predicting how a group of people from a given culture may react in a given scenario.

Power Distance Index

Power distance is defined as "the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally" (Hofstede et al., 2010 p61). Countries with a low power difference score are characterised by subordinates being treated more equally to authority than those with a high power difference. For example, children are more likely to be asked their opinion by parents and teachers and employees are more likely to be consulted by bosses in low power difference cultures, showing interdependence between subordinates and their superiors. Independence is also encouraged and praised by low power difference cultures. High power difference cultures conversely will expect a greater level of respect to be shown for authority and subordinates are allowed and expected to be more dependent upon their superiors.

Hofstede's power difference is defined in terms of the less powerful within a relationship (i.e. all participants in the questionnaire were answering questions about the power difference between themselves and their boss, not themselves and their employees) and the scores have been created based on results from a predominantly middle class sample. Hofstede (ibid) demonstrates that amongst the lower class, less well educated and less skilled jobs are not consistent with the middle class scores. In countries with low power difference these sub-groups will show greatly increased scores; in countries with high power difference the variation is smaller across different social classes, education levels or job type.

Individualism versus Collectivism

"Individualism pertains to societies in which the ties between individuals are loose: everyone is expected to look after him- or herself and his or her immediate family. Collectivism as its opposite pertains to societies in which people from birth onward are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty" (ibid p92). In an extremely collective culture opinions are held by a group rather than an individual; when asking someone from a collectivist culture for an opinion, if they are not aware of their group's opinion they will need to consult with the group before responding. Maintaining social harmony is more important than expressing individual concerns. In many collectivist cultures it is not considered polite to use the word 'no' directly and it would be unthinkable to voice opinions that do not observe the hierarchy that exists, for example by a son disagreeing with his father in public.

Hofstede highlights the implications of this cultural dimension for cross cultural business relations, particularly where a manager from an individualist culture is managing employees from a collectivist culture. He points out that, "Management techniques and training packages have almost exclusively been developed in individualist countries, and they are based on cultural assumptions that may not

hold in collectivist cultures" (ibid p122). Management strategies often rely on setting individual targets and objectives for employees and giving individual feedback. Hofstede refers to Christopher Earley's experiment (Earley, 1989), which demonstrated that Chinese participants in the experiment were more productive when given group objectives and asked to work anonymously than when given individual objectives and assigning their name to their work. The American participants, by contrast, were much more effective when given individual tasks but their performance was, "abysmally low when operating as a group and anonymously" (Hofstede et al., ob cit. p121). China scores 20 for individualism compared to the United States score of 91.

It is socially unacceptable to give very direct personal feedback in a collectivist culture as any bad feedback will cause the employee to lose face and social harmony will be disrupted. Rather, if an employee is performing badly, it is necessary to indirectly show unhappiness with the employee by removing privileges or go through an intermediary to pass on the message of bad performance. The intermediary should preferably be an elder member of the employee's in-group such as a member of their family.

It is much more usual in a collectivist culture to work alongside others in ones own in-group. It is acceptable to employ one person over another because they are a family relation or of the same ethnicity. For an individualist society this is morally unacceptable as individuals should be employed on the basis of the skills or knowledge they can bring to the business. Hofstede notes that for managers working in a collectivist culture, "It often makes good sense to put persons from the same ethnic background into one crew, although individualistically programmed managers usually consider this practice dangerous and want to do the opposite" (ibid, p121). Incentives are then more effective when offered to the group as a whole.

Masculinity versus Femininity

“A society is called masculine when emotional gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success, whereas women are supposed to be more modest, tender, and concerned with the quality of life.

A society is called feminine when emotional gender roles overlap: both men and women are supposed to be modest, tender, and concerned with the quality of life” (ibid p140).

Masculinity versus femininity is the most contentious of Hofstede’s dimensions of culture, being considered politically incorrect mainly in more masculine cultures (ibid, p144). Hofstede asserts that young girls and boys are socialised to “learn their place in society, and once they have learned it, the majority of them want it that way” (ibid, p151). Masculinity also varies according to occupation and of the six types of occupation at IBM engineering is the second most masculine, only after sales representatives. Another way of labelling masculinity versus femininity could be performance-orientated versus cooperation-orientated (ibid, p144). This makes clear the implications that this dimension has within the work place for effective management of employees and even the type of industry or task at which a particular culture is more likely to excel.

Uncertainty Avoidance Index

“The extent to which the members of a culture feel threatened by ambiguous or unknown situations” (ibid, p191)

According to Hofstede, cultures with higher uncertainty avoidance index (UAI) scores should in theory be more time conscious and less tolerant of others tardiness. UAI also has implications for a culture’s use and acceptance of technology, laws and rules, and religion within society. Each in their way can be used to lessen

uncertainty, technology can lessen the uncertainties caused by nature, law restricts uncertainties of human behaviour and religion lessens uncertainty over things that cannot be controlled (ibid, p189).

Uncertainty is intimately linked to perceptions of danger, “what are dangerous and polluting are things that do not fit our usual framework of thinking, our normal classifications” (ibid, p200). This is important to note as it links familiarity and danger with a negative correlation. Perceptions of danger along with coping mechanisms are learned and children from different cultures will learn different things are dangerous and learn different ways of coping. Hofstede uses the example of Germany, with a high UAI score, to demonstrate that a culture’s weakness in one situation can become its strength in another. Countries with high UAI are more susceptible to fascism and racism due to a fear of the unknown. The high UAI that made Germany vulnerable to the ideas of Hitler, however, provided the impetus for fast recovery of the country economically after World War II (ibid, p225).

When combined with power distance index, uncertainty avoidance index can be very useful for identifying the type of organisational structure that may be most successfully applied in a given culture. Hofstede, utilising the work of Owen James Stevens, identifies four types of organisational structure depending upon these two dimensions, which he calls, ‘implicit models of organizations’ (ibid, p302 onwards).

- High PDI and high UAI, ‘pyramid of people model’: Measures are implemented to centralise authority and structure activities to avoid uncertainty.
- High PDI and low UAI, ‘extended family model’: Authority is centralised but structure is more flexible and decisions are left to the ‘grandfather’ of the business to determine the best course of action.

-
- Low PDI and high UAI, 'well oiled machine model': Activities are structured such that everyone knows what their role and remit of responsibility is to avoid uncertainty but authority is not centralised.
 - Low PDI and low UAI, 'village market model': Neither are activities well structured nor control centralised, and members of the organisation are required to negotiate with others in the organisation according to any given circumstance to find the best way forwards.

Long-Term Orientation (added in 1991)

"Long-term orientation stands for the fostering of virtues oriented toward future rewards – in particular, perseverance and thrift. Its opposite pole, short-term orientation, stands for the fostering of virtues related to the past and present – in particular, respect for tradition, preservation of 'face,' and fulfilling social obligations" (ibid, p239).

Long-term orientation is a dimension that did not appear from the original IBM survey. It originally arose from the Chinese Value Survey and it is no accident that this dimension was found from a survey designed by Eastern minds (ibid, p238). The values conceived of, and therefore included in the survey, are related to the nationality of the survey designers. The Chinese Value Survey did not reveal the dimension uncertainty avoidance index and the Western designed survey did not reveal long-term orientation. All other three original IBM dimensions had equivalents in the Chinese survey.

Cultures scoring high on uncertainty avoidance are concerned with finding absolute truth. Conversely, societies scoring high on long-term orientation are concerned with virtue (ibid, p247). High scores of LTO are associated with Confucian values (especially persistence and thrift); Confucius "dealt with virtue but left the question of truth open" (ibid, p247). In this way cultures with high LTO can believe that A is true but B, the opposite of A, can also be true. In general the West has a shorter-

term orientation than the East; in the West if A is true then B, the opposite of A, cannot be true (ibid, p249).

Indulgence versus Restraint (added in 2010)

“Indulgence stands for a tendency to allow relatively free gratification of basic and natural human desires related to enjoying life and having fun. Its opposite pole, restraint, reflects a conviction that such gratification needs to be curbed and regulated by strict social norms” (ibid, p281).

High scores on the indulgence end of the scale are associated with happiness, life control and valuing leisure time.

Other Theories: Concepts of Time and Space

Over the last forty years Hofstede has kept abreast of developments in the field of cultural theory and each new development has been analysed to identify implications for Hofstede’s own work. In some cases this has led to the inclusion of new dimensions, as was the case with LTO and IVR. In other cases, alternative models have been broken down and component parts of the alternative dimensions have been found to correlate with Hofstede’s and thus no amendment of Hofstede’s dimensions has been required. Many replications have supported the validity of Hofstede’s work. Six replications are dealt with in Hofstede’s latest book, Hoppe (1990), Shane (1995), Merritt (2000), de Mooij (2004) Mouritzen and Svara (2002), and van Nimwegen (2002) (Hofstede et al., 2010).

As many theories are incorporated into Hofstede’s work they have not been discussed here separately. That said, there are some other theories, in particular in relation to time and space, which contribute further to understanding the role that culture can play in people management.

Edward T. Hall (1959, 1983) has written about the way different cultures approach time differently; he categorised cultures as holding either a monochromatic or a polychromatic concept of time. For a monochromatic culture time is linear, tasks happen one at a time in a predefined sequence. Time is inflexible, tangible and must be kept to. Polychromatic time is the opposite, it is circular, tasks happen simultaneously and time is flexible with relationships being prioritised over keeping time and less emphasis placed on being on time. Trompenaars and Hampden-Turner (1997) identify a similar cultural dimension though labels it 'Time as Sequence' versus 'Time as Synchronisation'. Hofstede notes the implications of uncertainty avoidance on time (the more uncertainty adverse a nation is, the more likely it is to observe strict timekeeping) but does not go further to suggest that there are two entirely different conceptions of time.

Mayers and Lingenfelter (2003) also compare Western and African concepts of time in a very relevant manner. Traditional African culture sees time as marked by naturally occurring events which occur in irregular and variable time periods rather than rigidly marked out by a clock. An African who holds this viewpoint will not become stressed by an event occurring later than scheduled, whereas this can lead to a deep rooted feeling amongst Westerners who feel that time is being wasted. For the African, it is the event that marks the fact that time is passing. When the event is over, the time has passed, irrespective of whether the Westerner's watch indicates that this has taken one hour or one week.

Hall has also written extensively about different cultural concepts of space (1959, 1966). Hall is predominantly concerned with the study of personal space, which he calls proxemics, and the silent messages that are communicated through the use of space. Cultures appear on a scale from high territoriality to low territoriality. Highly territorial cultures have a greater concern for ownership, so this dimension could in some ways be linked to Hofstede's Individualism, and tend to need greater personal space. Cultures with low territoriality are in general less aware of space.

3.3 METHODS

The research questions outlined in Chapter 1 are concerned with perceptions about the case study water and sanitation projects from the point of view of both the community and the author. As outlined above, perceptions are more appropriately explored with the use of qualitative methods. The methods used during research are listed below:

3.3.1 Unstructured Informal Interview

Unstructured informal interviews allow issues to materialise that had not been preconceived by the researcher. A further advantage of using this method is that it allows participants to provide data in their own way.

3.3.2 Semi-Structured Interview

Semi-structured interview allows open ended answers to preconceived questions.

3.3.3 Observation

Observation was used as a method in its own right to gain insights into the day-to-day lives of members of the participation community and to collect data relevant to the water and sanitation projects. In addition, observation was used to triangulate data collected by other methods.

3.3.4 Reflection

Reflection was the predominant method used to identify occasions where research products were affected by issues of researcher positioning or research process.

3.4 ADVANTAGES AND LIMITATIONS

The previous sections have provided some justification for the rationale which informs the research and the research approach taken. This section moves on to make explicit some of the advantages and limitations of the approach selected.

3.4.1 Advantages of Methodological Approach

One of the key advantages of critical realism, and the reason it has been chosen to frame the research question, is its appropriateness for the multifaceted context of water and sanitation projects. It allows the flexibility to select the most appropriate methods to explore the research subject, which is dependent upon the particular aspect of reality in question.

A critical realist perspective attributes agency and an ability to reflect to human beings, they are not the unthinking robots a naturalistic outlook would presume. Given the same environmental pressures and conditions, some humans will behave in one way and others in another. As described in Chapter 2, one of the goals of community development projects is to enable communities to have more control over their own lives through empowerment. It seems philosophically inconsistent to expect this outcome when taking a naturalistic approach as on the one hand humans are attributed with the agency to become empowered but on the other this agency is not considered to impact on research.

Critical realism promotes a move away from the hypothetic-deductive process required by a scientific methodology. This has the advantage of allowing previously unforeseen but important discoveries to be made during the research process. Cronbach (1975 P124) recognises the benefits of this when he says, “there are more things in heaven and earth than are dreamt of in our hypotheses, and our

observations should be open to them". This seems particularly relevant in contexts such as the international one surrounding this research. The researcher is working in an unfamiliar culture and society where many essential considerations may not have previously entered the realm of the researcher's imagination.

Of fundamental importance to this research is the fact that critical realism is a framework that can manage research in open systems, such as the ones found in real live situations. Unlike a positivistic method, a critical realism approach does not require the researcher to be able to control all aspects of the study. Instead causal relationships are thought of in terms of probability and tendency and it is accepted that on some occasions actions do not cause the anticipated outcome due to the occurrence of other, unforeseen mechanisms interfering (Robson, 2002).

The combined use of case studies and action research has the advantage that the research remains relevant and tackles real problems experienced during real water and sanitation projects.

3.4.2 Limitations of Methodological Approach

Whilst in many ways it is clear that to really tackle the issues surrounding water and sanitation projects a mixed methods approach is required, it is inevitable that some issues arise that require consideration.

The first relates to the problem of ability to generalise findings that arises due to the choice to focus on a small number of case study projects, and gain in depth understanding of a small group of participants. For the research to have a wide reaching impact and be of genuine value to engineers, the findings need to have implications beyond the communities consisting of a few hundred people who participated in the research.

This research moves away from a naturalistic perspective, in which reality is seen as independent of human interpretation and the goal of research is to uncover universal truths. In a naturalistic approach there are well defined statistical techniques that can be applied to test the representational quality of findings. Findings must be repeatable and this means that if all the factors which impact on a particular outcome can be identified, then application of the same factors to the same degree will produce the same results. In other words, using naturalistic methodology, generalisations are possible.

By taking a critical realist approach, this research acknowledges that some aspects of reality are dependent upon human interpretation. This means that different people placed under the same environmental conditions may behave differently. This could be because they interpret the situation in a different way or, perhaps, just because they have different personalities. When human agency is factored into research findings it becomes much more difficult to argue that research findings can be generalised to other situations. Critical realism deals with this problem by outlining the context within which mechanisms operate. It is accepted that definitive relationships are not established but instead probabilistic relationships uncovered.

Throughout the results chapters an effort is made to identify the *context* within which key findings are likely to be relevant. In other words, the goal is to identify, explore or explain social and cultural factors pertinent to engineers working on water and sanitation projects and then discuss the boundaries within which these factors are likely to be relevant. The boundaries may be geographical, or relate to issues such as social organisation or cultural dimensions.

A further upshot of framing the research with a critical realism paradigm, and choosing to employ an action orientated approach to the research, is a move away from the positivistic assumption that the researcher is neutral, even absent, from the

research process. This research (in line with a critical realist standpoint) holds that researcher neutrality is an unattainable aspiration for all lines of research inquiry, including quantitative as well as qualitative. This research takes the opinion that if researcher neutrality is an unachievable myth then the inherent biases in the researcher's perspective are better explored and made explicit rather than reduced (as far as possible) and then ignored.

As explained above, reflexivity is the method employed to account for the implications of researcher presence in the research. It is necessary to acknowledge the limitations of reflexivity, the human limitation to genuinely see a situation from another's perspective. As Young (1997) puts it, "when people obey the injunction to put themselves in the position of others, they too often put themselves, with their own particular experiences and privileges, in the positions they see the others. When privileged people put themselves in the position of those who are less privileged, the assumptions derived from their privilege often allow them unknowingly to misrepresent the other's situation".

However, if it is believed that objectivity and neutrality are unrealistic goals of research, then some attempt to understand the impact of the self of the researcher is required. As Becky Ropers-Huilman notes, "as witnesses, there is a sense that our knowledge from participation in a research setting is useful... that our constructed meaning might be worth listening to as we seek to improve our worlds" (in Pillow 2003). In other words, research can be useful despite being a "translation" with the researcher acting as translator.

3.5 ETHICAL CONSIDERATIONS

Research took place through case studies of *real* water and sanitation projects with *real* impacts on the lives of participants and this introduced a risk that research

could cause *real* harm. The ethical statement prepared prior to undertaking the research is presented in Appendix A.

Ethical considerations impacted on the methodology for the research due to the fact that research aims had to be a secondary priority to the aim of acting in the best interest of the participants. It would have been ethically unacceptable, for example, to trial at one community a stakeholder engagement method thought to be beneficial and withhold the use of this method in another community as a 'control' to compare the additional benefits brought by the method.

There is a strongly ethical dimension to the use of reflexivity as it provides the researcher with the tools to examine the impact that research is having on participants. Through reflexive practices the researcher can become more attuned to any negative side effects of the research on those involved and from there decide on the right path on which to proceed. As Pillow (2003) notes, reflexivity can "situate the research as non-exploitative and compassionate". Etherington (2004) outlines how reflexivity helps to create the open dialogue and transparency between researcher and researched that is necessary to perform research ethically.

Farhana Sultana (2007) posits the importance of reflexivity in fieldwork, emphasising the need to "pay greater attention to issues of reflexivity, positionality and power relations in the field in order to undertake ethical and participatory research". She goes on to stress that this is even more critical "in the context of multiple axes of difference, inequalities and geopolitics", such as the context within which this work will be undertaken.

4 Case Studies

The findings presented in the results chapters 5 to 8 are based on case studies of water and sanitation projects carried out in communities in Ghana. This chapter first provides background information about Ghana and then moves on to introduce the case study communities and project aims.

4.1 GHANA

Ghana, formally the Gold Coast, is situated on the Gulf of Guinea in West Africa with an estimated population of 24.2 million (World Bank Data - 2010). Independence from the United Kingdom occurred in 1957 and following elections in 1992 Ghana now operates a multi-party democratic political system. Ghana is ethnically diverse with more than one hundred different ethnicities and seventy-nine different languages spoken throughout the country. English is the official language though nearly everyone in the country speaks a local language and members of more rural communities may have little English. Ghana is resource rich, with a wide range of assets including gold, petroleum, diamonds, fish and hydropower among others (CIA, 2010).

4.1.1 Economic Development

The Gross domestic produce (GDP) per capita based on purchasing power parity is shown in figure 4.1 for Ghana, the GDP of the United Kingdom is also shown for comparison along with the average for Sub-Saharan Africa and the World. The figures have been adjusted to reflect real purchasing power to account for the fact that a dollar spent in the United Kingdom will not buy the same amount of goods as a dollar spent in Ghana. Had Gross National Income been presented instead of

GDP the graph would have looked incredibly similar. Ghana is classified as a lower-middle income country.

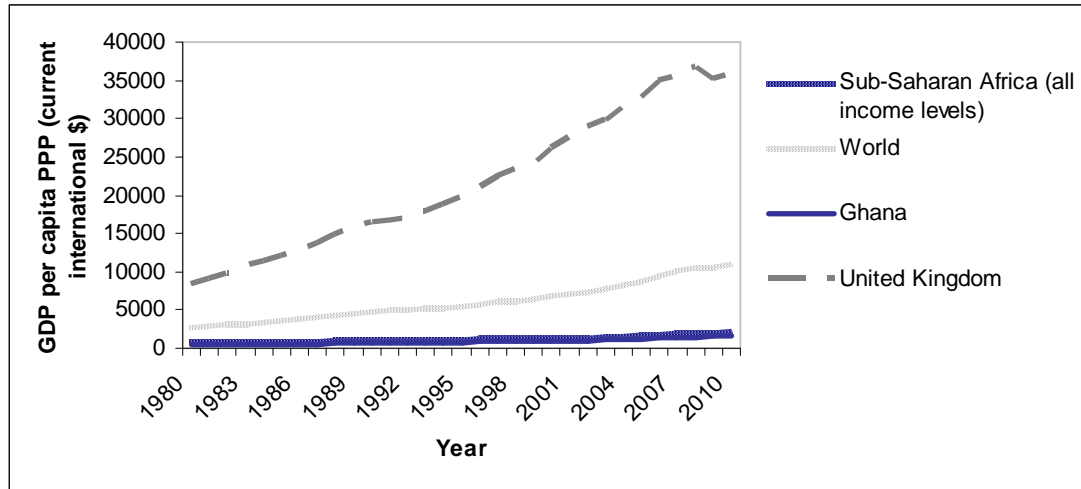


Figure 4.1: Gross domestic produce (GDP) per capita based on purchasing power parity for Ghana, the United Kingdom, Sub-Saharan Africa and the World from 1980 to 2011 (based on World Bank Data)

Just looking at the average income does not tell the whole story however. Levels of poverty are dependent upon the distribution of income within a country. Figure 4.2 presents the Lorenz curve for Ghana, which shows how income is distributed throughout a country. The Lorenz curve for the United Kingdom is shown for comparison but there is no data for either Sub-Saharan Africa or the World. A percentage of income is plotted against a cumulative percentage of the population starting with the poorest, so for example it can be seen that the poorest twenty percent in Ghana survive on only 5.2% of the country's income. There are no figures for both Ghana and the United Kingdom collected in the same year so the most recent figures have been shown for each country. For the United Kingdom this was 1999, for Ghana 2006. Income inequality can be seen to be similar in the United Kingdom and Ghana.

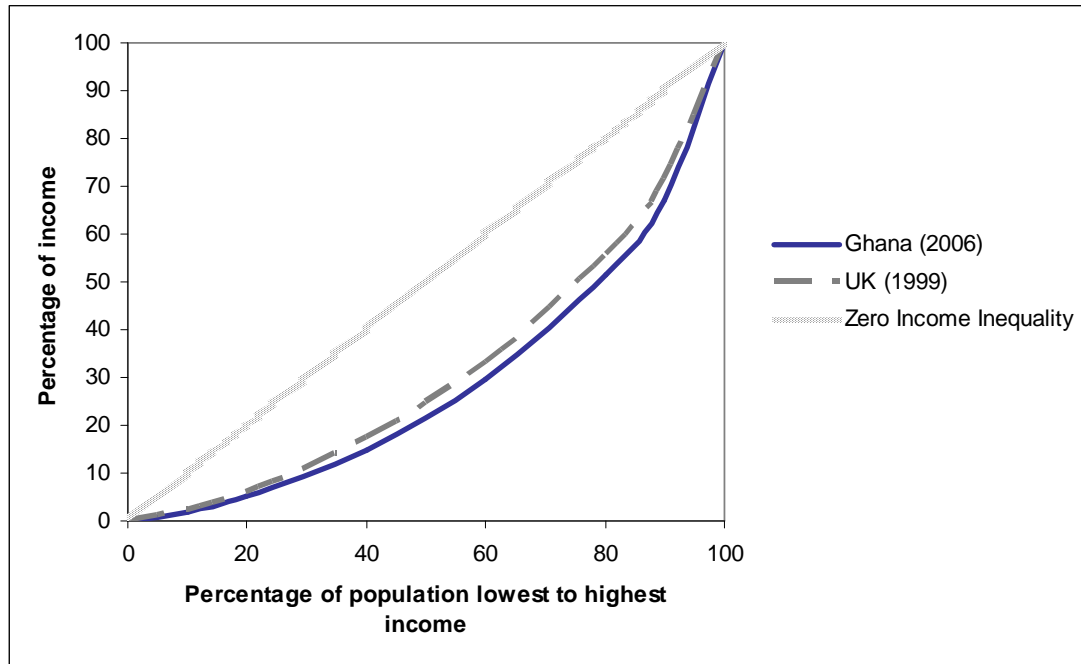


Figure 4.2: Lorenz curve for Ghana and the United Kingdom (World Bank Data)

Income inequality also has geographic characteristics. Figure 4.3 shows the percentage of the population living in rural areas for Ghana, with the United Kingdom, Sub-Saharan Africa and the World provided as comparisons. The worldwide trend is towards urbanisation but in Africa rural populations are likely to remain in the majority until 2050 making the eradication of rural poverty an all the more pertinent task (IFAD, 2011).

Figure 4.4 shows the percentage of the population of Ghana living below the poverty line for both national and rural populations. The poverty line is defined according to the national standard set by the Ghanaian Government and this standard is well below the international poverty line standard. Extreme poverty/poverty according to the National line is set at 0.21/0.25 Ghanaian Cedi compared to the international standard of \$1.25 (approximately 2.11 cedi)/\$2 (approximately 3.38 cedi) (at a conversion rate of \$1 to 1.688 Ghana Cedi, the exchange rate on 26/02/12). Therefore the data underestimates the total percentage

living in poverty. It is however useful to show the disparity between poverty in rural and urban areas.

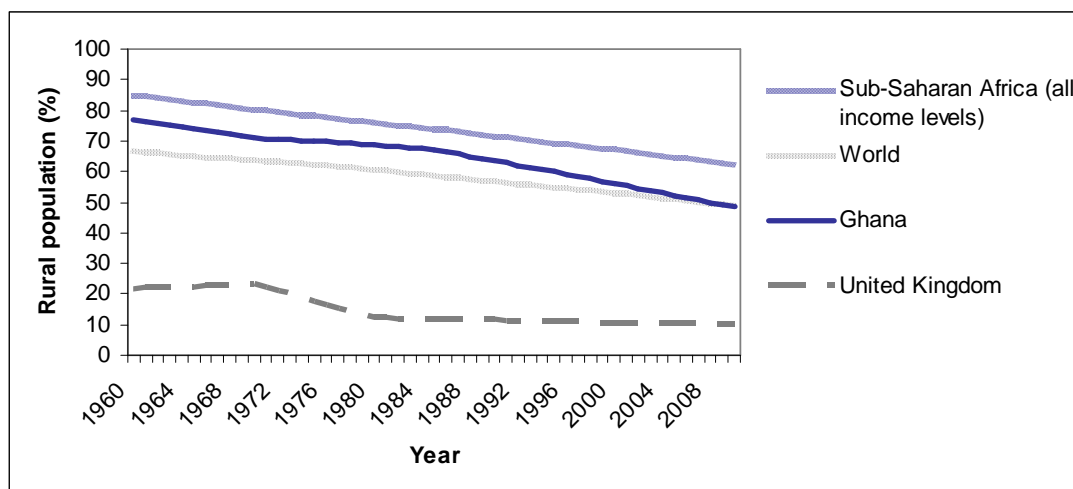


Figure 4.3: Percentage of population living in rural areas (World Bank Data)

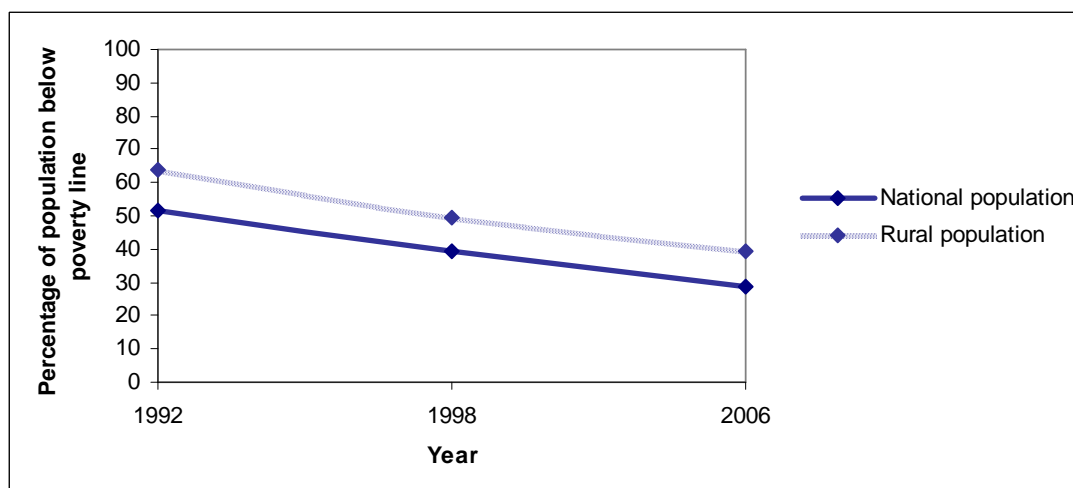


Figure 4.4: Percentage of national and rural population in Ghana living below the national poverty line (World Bank Data)

4.1.2 Human Development

The United Nations Development Programme has devised the Human Development Index (HDI) as a way of overcoming the limitations of economic

statistics such as GDP. The HDI considers development to encompass a broader range of issues than simply income. The HDI incorporates aspects of health and knowledge as well as standards of living. HDI is calculated from life expectancy at birth, adult literacy, enrolment in primary, secondary and tertiary education and GDP per capita. Figure 4.5 shows the HDI trend for Ghana, the UK, Sub-Saharan Africa and the World. Whilst Ghana performs marginally worse than the average for Sub-Saharan Africa for GDP per capita, it scores above average for human development.

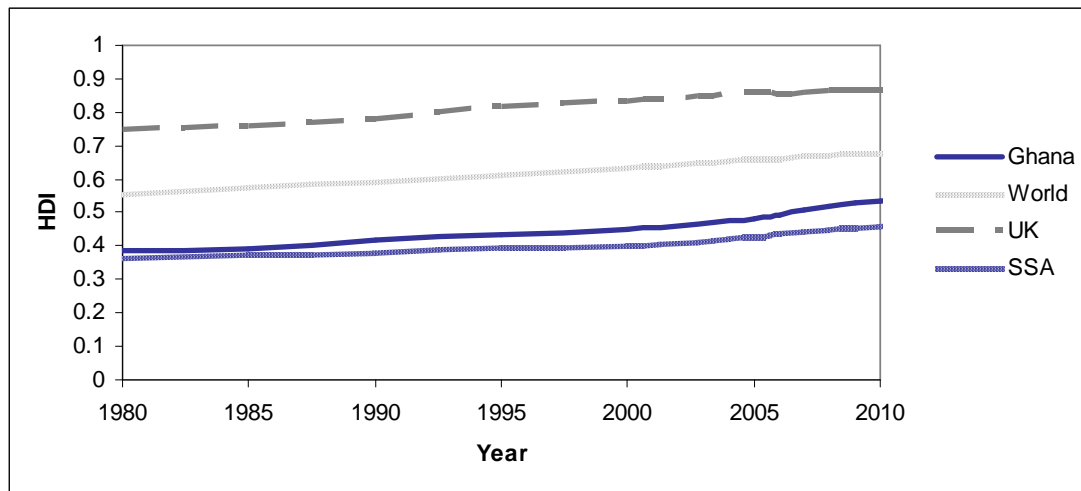


Figure 4.5: Human Development Index trends for Ghana, the United Kingdom, the World and Sub-Saharan Africa (UNDP, 2011)

In 2010, the Human Development Report included a new index called the Inequality-adjusted Human Development Index (IHDI) (UNDP, 2010). In 2011 Ghana scored 0.367 following adjustment and the United Kingdom 0.791. The lower the original HDI score the greater the adjustment for inequality tended to be across the countries included in the report.

4.1.3 Environment

Ghana has within its borders the largest (by surface area) man-made lake in the world, Lake Volta, which is dammed at Akosombo and has a surface area of over 8,500km² holding 148km³ of water. Whilst the whole of the lake is within Ghana's borders the river basin crosses Cote d'Ivoire, Burkina Faso, Togo, Benin and Mali. Water levels are extremely variable in the Lake due not only to variation in rainfall but also water management decisions taken by upstream countries. Water levels reached minimum operating levels of about 72m in both 1980 and 1998; up until 1998 water levels peaked at around 84m (Van de Giesen et al., 2001).

There is also accessible groundwater which is mostly of good quality except in some localised areas (Water Resources Commission of Ghana, 2008). In parts of the Western Region groundwater contamination with heavy metals has occurred as a result of mining in the region. A limited number of geographic areas suffer from groundwater with high levels of chemical contaminants such as fluoride and arsenic, principally in the Upper East Region in the North of Ghana. Problems with high iron concentrations are more widespread. Some coastal aquifers have increased salinity due to seawater intrusion (Shafer et. al., 2009; British Geological Survey, 2001).

Rainfall is highly variable, both throughout the year and on longer timescales, and long term trends are difficult to predict as shown in figure 4.6, which shows historic precipitation in Ghana for January, February, March and April, May, June along with the average monthly precipitation over the year (data from The University of Oxford, School of Geography and the Environment, n.d.). The North of the country experiences only one rainy season and the South two, although in the south it is actually a pseudo-bimodal regime (Van de Giesen et al, 2001). Ghana suffered severe drought in the mid 1980s and a more minor drought in 1997 (ibid).

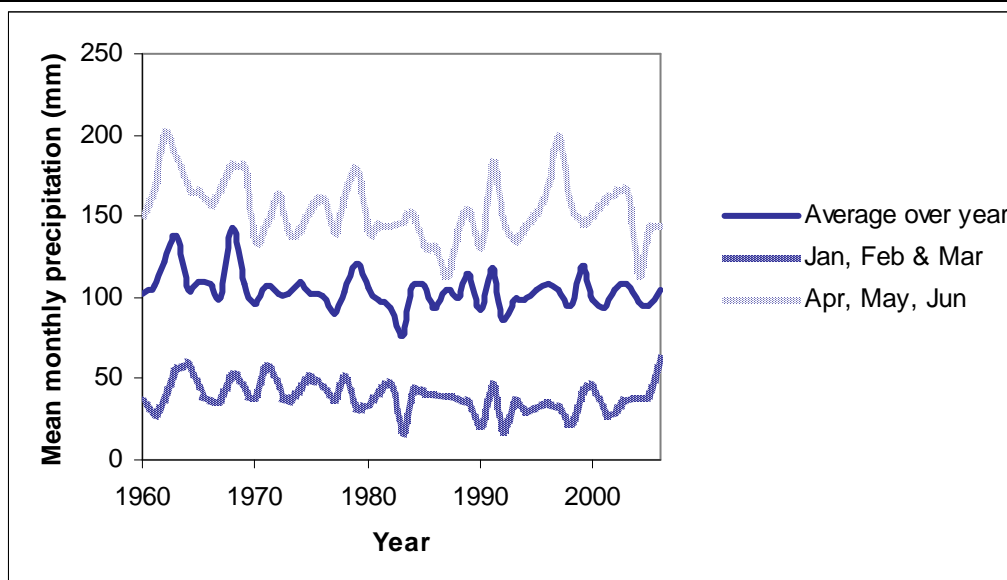


Figure 4.6: Mean monthly precipitation in Ghana, January, February, March and April, May and June with yearly mean 1960 to 2006 (data from The University of Oxford, School of Geography and the Environment, n.d.)

Figure 4.7 shows that the availability of freshwater resources per capita is lower than that of the United Kingdom and the averages across Sub-Saharan Africa and the world. The trend is also downwards with less resource per capita shown in each consecutive five year period.

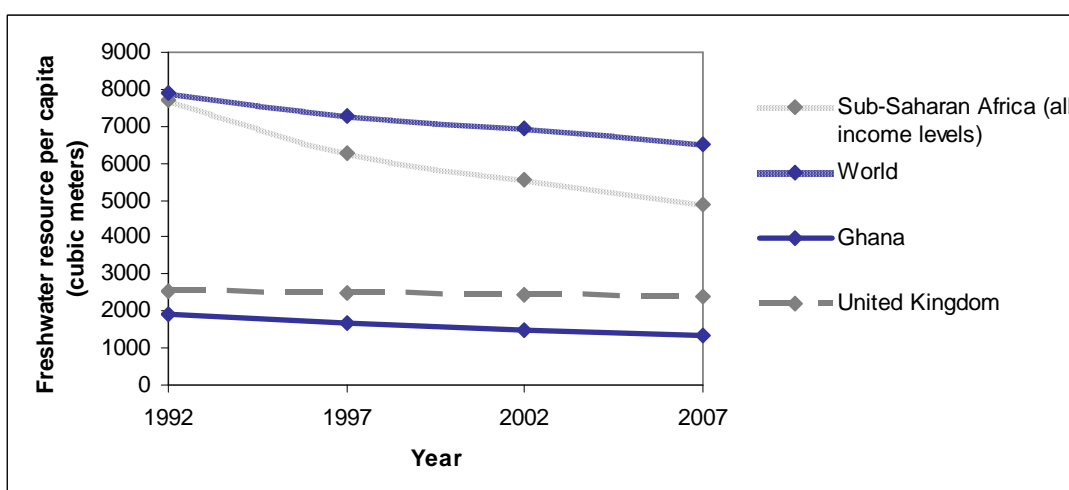


Figure 4.7: Freshwater resource per capita for Ghana, the United Kingdom, Sub-Saharan Africa and the World (World Bank data)

The total water withdrawals in Ghana are estimated to be around 0.98km³/yr which is a per capita usage of 40m³/yr (FAO aquastat, 2011). Of this 24% is for domestic use, 66% for agricultural and 10% industrial. The Domestic water use per capita is 10m³/yr which is just over 27 litres per person per day usage. This is very low; Gleick (1996) has recommended a minimum of 27 litres per person per day as necessary for meeting basic needs including drinking, sanitation, bathing and cooking. The average usage of 27 litres per person per day suggests that many will be using below that necessary for basic health and hygiene needs. Freshwater resource availability is estimated to be 53.2km³ annually for the whole of Ghana, so the 0.98km³ currently used is well within water resource availability (FAO aquastat, 2005).

4.1.4 Culture

The previous chapter introduced a number of existing theories of culture. Table 4.1 shows a comparison of Ghana's and Great Britain's scores based on Hofstede's six dimensions of culture. Explanations for each dimension are provided in section 3.2.2. Note that for the first four dimensions, PDI, IND, MAS and UAI the scores are actually for West Africa which includes Ghana, Nigeria and Sierra Leone. Scores for LTO and IVR are specifically for Ghana.

Dimension		Ghana	Great Britain
Power Difference Index	PDI	77	35
Individualism versus Collectivism	IND	20	89
Masculinity versus Femininity	MAS	46	66
Uncertainty Avoidance Index	UAI	54	35
Long-term versus Short-term Orientation	LTO	4	51
Indulgence versus Restraint	IVR	72	69

Table 4.1: Hofstede's cultural dimension scores for Ghana and Great Britain

In general this shows that Ghanaian culture has greater power differences in social and work structures, is much more collectivist, a little more feminine, more uncertainty adverse, much shorter-term orientated and only ever so slightly more indulgent than UK culture.

4.2 CASE STUDY PROJECTS

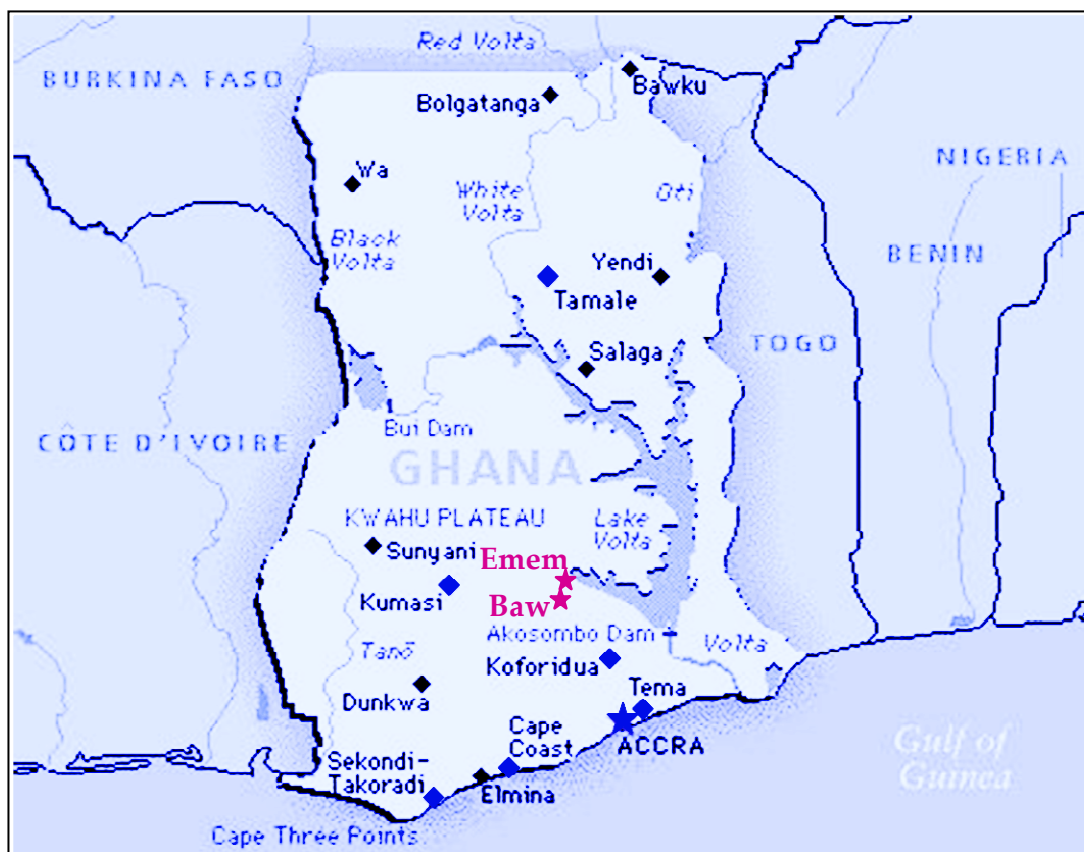


Figure 4.8: Approximate locations of case study projects in Ghana

4.2.1 The Project at Emem

Emem is a small village situated on the southern shore of the western arm of Lake Volta in Ghana's Eastern Region. The approximate location of the village is marked on the map of Ghana in figure 4.8. It has a population of around 200 people, the predominant ethnicity in the village is of Ewe lineage. Prior to the project, the

community collected their water from the lake and all but one household used the water without any form of treatment, with inevitable health consequences. A handful of families had dug their own simple latrines consisting of a pit with a floor made from timbers and mud and walls made from timbers recycled from old boats. Apart from these few people, the rest of the community had no form of toilet.

The village had been visited by a local Non-Governmental Organisation (NGO) but had been left disappointed as the NGO had been unsuccessful in their attempts to source ground water. The NGO use the same approach for all their projects and only use borehole technology in the provision of water to communities. The NGO have a good approach to their projects, incorporating community management and an educational programme into their work, but they do not have engineers working for them who can advise on a range of appropriate technologies that could be employed. As a result, the NGO have been unable to help communities such as Emem where they have not found groundwater, and the village had been left without access to clean water.

The project at Emem was intended to be a combined water and sanitation project. A water system has been implemented at the village but the toilets are yet to be built due to construction issues which are discussed further in Chapter 7.

4.2.2 The Project at Baw

Baw is a small village situated forty minutes drive off the Mpraeso-Adowso road along a badly maintained dirt track road, also in the Eastern Region of Ghana. An approximate location is shown in figure 4.8. At the start of the project there was a very run down school located in the village, which was structurally unsound and badly in need of repair. The school had been a government school in the past but teachers had been unwilling to stay in the village due to the lack of water and sanitation facilities and proliferation of insects in the village, and so had deserted

their posts. The project was taken on as a joint school building / water and sanitation project.

The village consists of approximately 250 people of predominantly Akan origin, speaking the Twi dialect. Prior to the project commencement, very few children in the village attended school, those that did were travelling considerable distances each day and as such tended to start school late and be older than their peers in their class.

Currently the school building has been repaired and painted and a toilet block has been constructed at the school, comprising three dual pit ventilated latrines. One of these was to be for the girls, one for the boys and one for the teachers. Further funding is currently being raised for completion of a water solution.

4.2.3 Project Management

The project team consisted of the author, acting as engineer and project manager. The project was carried out under the auspices of Original Volunteers Ghana, an organisation involved in a variety of development projects in the local area. Funding for the projects came from fundraising carried out in the UK and generous donations from friends and family of the author. The project employed local skilled labour when necessary, including two masons, two carpenters, a steel bender and a plumber. Manual labour was largely carried out by the beneficiary communities.

5 Design Parameters

This chapter is concerned with the implications of socio-cultural context for the design of rural water and sanitation systems and aims to identify design parameters which may impact on the likelihood of systems being sustainable in the long term.

The chapter describes the design of the water and sanitation systems at the case study projects of Emem and Baw and considers the ways in which socio-cultural factors informed the design. In addition to quantitative, technical and economic design parameters, qualitative social and cultural parameters are identified that had implications for the infrastructure design. Consideration is given to the importance of incorporating these more qualitative parameters into water and sanitation system designs to ensure projects are sustainable. It is concluded that engineers working on such projects need to be able to identify and incorporate socially constructed design parameters into their engineering designs.

5.1 RESEARCH AIMS

This chapter aims to:

- Identify design parameters for the design of the water system at Emem and the sanitation facilities at Baw which arise from the socio-cultural context;
- Consider the importance of including socio-cultural factors in engineering design to achieve project sustainability; and
- Consider the implications of findings for other engineers involved in water and sanitation provision in developing countries.

5.2 CHAPTER STRUCTURE

The chapter begins by presenting an argument, based on existing development theories, for the importance of incorporating softer, more qualitative factors alongside hard, quantitative, technical and economic factors into the design of rural water and sanitation systems. Following this a number of factors are identified from the literature, which are thought to be of potential interest to engineers as they may lead to issues which need to be considered during the design of systems.

The design of the systems at the case study communities of Emem and Baw are then described and consideration is given to the impact that the identified factors had on the design of the systems as well as the long term likelihood of sustainability. The chapter finishes by giving thought to the implications of findings at the case study projects for engineers working on other development projects in Ghana and further afield.

5.3 LITERATURE

5.3.1 Importance of Considering Social and Cultural Factors

Social and Cultural Factors in Development Thinking

Kottak's (1990) review of development projects of the 1960s and 70s found that many projects placed more emphasis on technical and financial factors than they did on social issues. For Kottak, this presented a fundamental issue in development thinking. Kottak uses Romer's Rule to explain why development projects need to think about socio-cultural context. Romer's rule explains evolutionary changes as arising out of a species desire to maintain its existing way of life (ibid). Put simply, an amphibian is simply a fish who needed to grow legs because his pond was drying out and he needed to be able to walk to a nearby alternative pond. Kottak applied this theory to development projects and asserted that understanding

people's existing way of life, and preserving valued social and cultural features, is crucial to increasing the likelihood of a successful outcome for a project. 'Over innovating', interventions which require a high degree of change, can be the cause of project failure (ibid).

Verhelst explains how culture in particular leads to values that determine whether communities accept or reject development interventions. "The ability to select outside influences, to make a choice, is extremely important. Every community must be able to make a free choice between what it considers to be useful and beneficial and what it considers to be superfluous and harmful... It is culture, which contains these values and determines the priorities; it is also culture which directs the choices in accordance with these priorities," (Verhelst 1994).

Relevance for Engineers

Romer's rule, applied to engineering aspects of community development, would suggest that communities are likely to engage in change and accept technologies that make it possible for them to maintain their existing way of life. Socially constructed realities such as cultural values and social structure are key aspects of their existing way of live. Understanding the local social and cultural context, and designing water and sanitation systems accordingly, would therefore appear to be vital in determining whether the project is likely to be accepted by the community and therefore whether the project is likely to be a success or not.

Verhelst's theory also suggests that cultural values should be a key concern of the foreign engineer involved in water and sanitation projects. The foreign engineer needs to consider how the proposed technologies, and the values those technologies embody, will be perceived by the local community. If the systems are not designed in a way that is a good cultural fit for the local community, it is possible that the development interventions will fail, wasting valuable resources and leaving communities without access to vital water and sanitation facilities.

5.3.2 Design Parameters Selected from the Literature

The literature highlights a number of factors relating to the context within which community water and sanitation projects are conducted that seem particularly relevant to the work of engineers. In the same way that technical or economic considerations may rule out the use of a particular technology, cultural considerations could rule out the use of a technology or demand its adaptation. This section will consider the reasons that these factors have been selected as relevant to engineers working on water and sanitation projects; later sections will look at the impact that these factors had on the design of the systems at the case study communities.

Community Development Priorities

Silkin (1998) concluded that one of the factors contributing to the success of a WaterAid project carried out in Ethiopia was the high priority that the participants of the project placed on their need for water. In this case the community's prioritisation of water supply arose out of the severe water shortage the community was facing. It was thought therefore that understanding community development priorities would be an important consideration during the case study projects as this would impact on the communities long term commitment to their projects.

Kottak (1990) points out that community goals of development often do not exist in the abstract sense that planners' sometimes assume, such as "learning a better way, progressing, increasing technical know-how, improving efficiency, or adopting modern techniques". Instead the community are more likely to, "have down-to-earth and specific objectives, such as maintaining yields in a rice field, amassing resources for a ceremony, getting a child through school, or paying taxes".

Willingness to Pay

Braimah and Fielmua (2011) differentiate between the ability of beneficiaries to pay, as dependent upon their employment status and wealth, from their willingness to pay. They give the example of the reduced willingness to pay for the repair of water systems they experienced in Ghana during rainy season due to the availability of free rain water. This reduction in willingness to pay was unrelated to the beneficiaries' ability to pay.

The sustainability of water and sanitation systems is likely to be as dependent upon willingness to pay as ability to pay and therefore needs to be considered during the design of systems.

Local Knowledge and Skills

It is important to remember that the local communities will have existing knowledge and systems in place for dealing with the water and sanitation issues they face. Annan (2000) points out that, "It is not uncommon for groups or individuals with special roles and knowledge to be present in the local community (including spring finders, water managers, and underground canal and well diggers)". Being aware of the local knowledge which exists in the community could present opportunities for the project, whilst failure to acknowledge existing knowledge could jeopardise relations with local people (ibid, p280).

Social and Cultural Factors

Baptista (2010, also see section 1.1 box 3), describes a water project in Mozambique which failed due to social and cultural factors being overlooked during the design of the system. The cultural convention at the community in question is to locate communal facilities in the centre of the village, where they can be overseen by the chief and elders of the community. In this project, the water collection area was located on the outskirts of the village as the water pump that had been acquired for the project was not powerful enough to pump the water as far as the centre.

In this case the quantitative technical considerations (the pump capacity) were allowed to transcend the qualitative social and cultural concerns (the need to locate communal facilities in view of the chief's house), to the complete detriment of the project and local community. Whilst it is clear that placing the water collection point outside the range of the pump will cause the project to fail, so too will locating the collection point outside the culturally acceptable area.

Religious Perceptions

Prior to the fieldwork it was thought that religious perceptions may have important implications for the water and sanitation projects. This theory in part arose out of literature such as Meyer (1999) who describes Ewe culture of Ghana. In Ewe culture, ancestral spirits inhabit various natural habitats. Some spirits chose to live in water and can become angered by water being drawn in containers made of modern materials (ibid, 1999). This has very apparent implications for engineers who plan to use a variety of manmade objects to suck water out of the lake and pump it into the local village.

Likewise, religious perceptions have been shown in the literature to have implications for the design of sanitation facilities. Advannavar and Mani (2008) have undertaken a useful review of different cultural approaches to sanitation, which includes a section on the implications of religion. Many religions contain references to excreta disposal in their religious text and some specify rituals that must accompany latrine use (ibid).

Some of the practices associated with religion seem to have clear implications for engineers. For example, Muslim latrine users often require water to be available for anal cleansing and squat direction preferences vary with some individuals preferring have their back to Mecca whilst others prefer to be side-on.

5.4 THE PROJECT AT EMEM

5.4.1 Design of the Water System at Emem

The water system implemented at Emem consists of a pump and water transmission pipe, which has been installed to bring water into the centre of the village, and an in line coarse gravel filter followed by slow sand filter, which has been constructed to treat some water to drinking water quality. A schematic of the water solution can be seen in figure 5.1. Figures 5.2 and 5.3 are photographs of the water treatment system and raw water collection area.

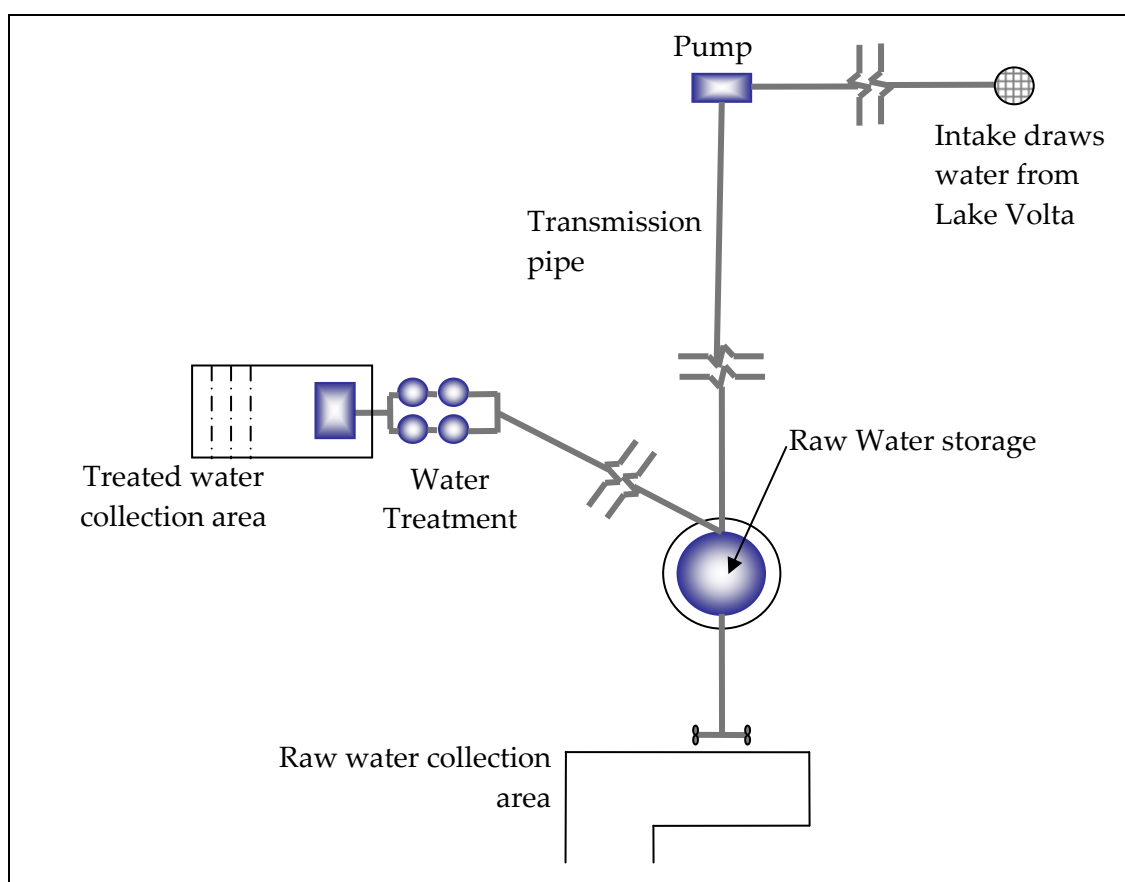


Figure 5.1: Schematic of the water system at Emem



Figure 5.2: Testing the water treatment system at Emem (left)

Figure 5.3: The raw water collection area at Emem (right)

5.4.2 Design Parameters

Technical Factors

The key technical issue encountered during the project was the difficulty in predicting water level in the lake. The water level changes rapidly as Lake Volta is dammed both upstream and downstream for hydropower production. There is also a high degree of seasonal variation in rainfall.

This made selecting the location for the pump problematic, as ideally the pump would be situated above the highest water level but always close enough to the water that the intake hose could reach the water at its lowest, without exceeding the suction capacity of the pump. The rapid variation in water level of in excess of 10 m (Giesen et al 2001) meant that the system had to be designed to be as flexible as possible. The final design of the water transmission system can be seen in figure 5.4.

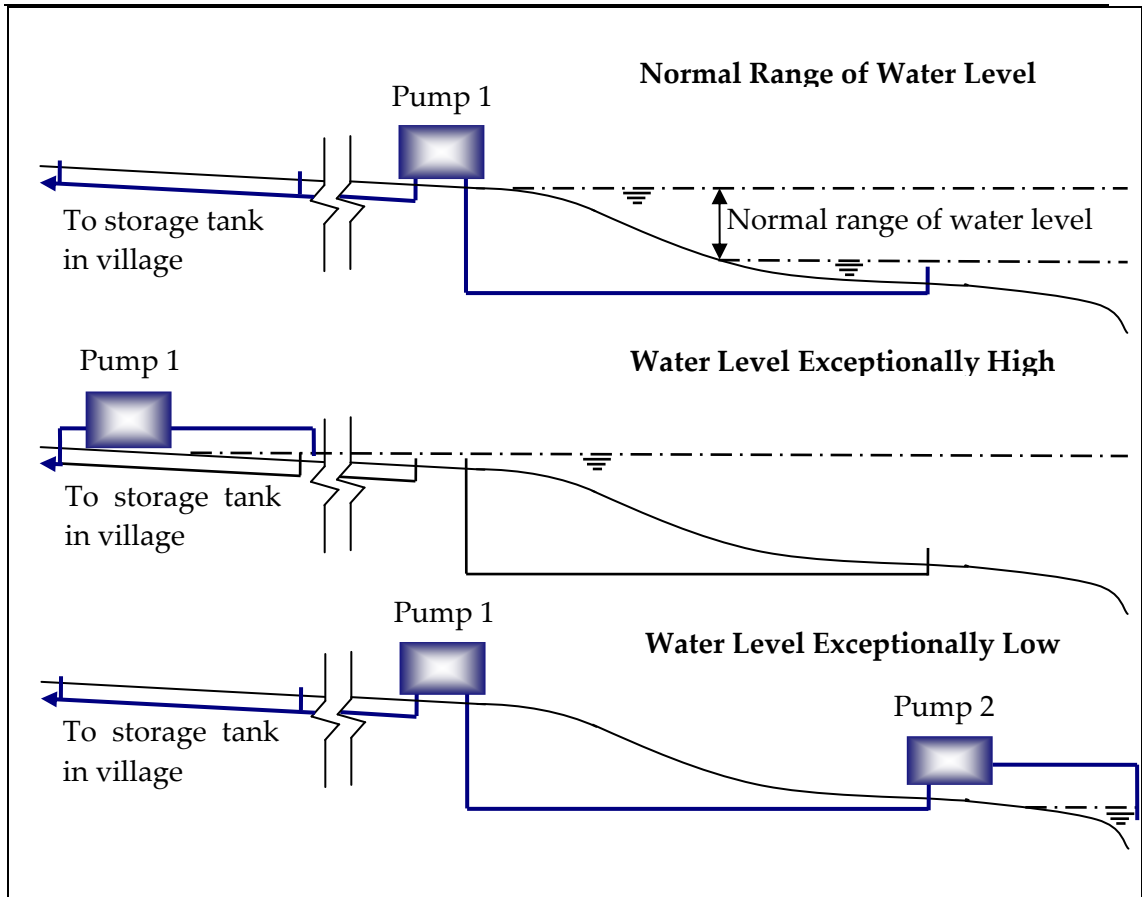


Figure 5.4 Schematic Elevation of Pump-Pipe System Installed in Emem

A permanent pump house is located where the pump would be positioned when the water level is within its normal range. A photograph of the pump house is shown in figure 5.5. At intervals along the length of the pipe to the village, 'T' sections have been fitted to cope with the possibility of the water level rising above the level of the pump house. In this situation the pump can be removed from the pump house and relocated at one of the 'T' sections above the level of the water. In this way water can still be pumped into the village. When the water level is extremely low a second pump can be connected in series with the first pump to pump the water from the lake to the intake of the first pump.



Figure 5.5: The pump house at Emem

The 'U' shaped intake means that for the majority of the time the water is collected a significant distance from the edge of the lake. This has the advantage of improving the quality of water taken into the system. The water close to the shore of the lake is of a lower quality with a higher risk of contamination by human and animal excrement.

Economic Factors

The water and sanitation system is reliant upon the ability of the community to pay the necessary funds to ensure petrol is available for the pump. In the longer term it can be expected that more substantial amounts of money will need to be available for replacement of parts of the system, for example when it is necessary to replace the pump. It was also anticipated that the implemented system would provide a first boost to the community in terms of improving the health of their village; it was hoped that the community would see the systems as a starting point from which to continue to improve and upgrade their systems gradually as more capital becomes available.

The estimated cost of running the pump to supply the water system was around 1 - 2 Ghana Cedi (£ 0.5 – 1). This provided enough petrol and oil for the pump to fill the 20m³ water storage tank in the village, which would supply the village for a couple of days. In initial discussions (firstly the chief and elders but also confirmed by other members of the community) the community were confident that they were able to pay the money required to keep the pump operating.

The idea for ensuring the long term sustainability of the system came from Abraham, one of the elders in the community. It was apparent that whilst the village could afford small running costs, they did not have the financial leverage to cope with large expenses such as pump replacement. Abraham introduced the idea of 'cow insurance'. 'Cow insurance' is a very simple idea whereby calves are purchased and reared into cows over the period of a few years. It is possible to buy a calf for about 150 Cedi (£75) and a mature cow can be sold for 7-800 Cedi (£350-400). A mature cow can therefore be sold to finance a new pump (costing around 350 Cedi) and new calf, still leaving a profit of about 200 Cedi that can be spent improving the community.

Community Development Priorities

The key development priority of the village was identified as having a more *convenient* water source as the community emphasised concern over the distance to the lake rather than the water quality. Whilst this had an impact on the design of the systems as it led to a focus on increasing the convenience of access to water for the community it was also decided that it would be necessary to talk with the community about the health implications of drinking low quality water.

Willingness to Pay

The community at Emem had asserted an ability to pay the cost of operation of the system implemented. Willingness to pay proved harder to gauge, especially during the early stages of the design process as willingness to pay was dependent upon the

extent to which the community felt the systems met their development needs. Therefore the design parameter which really informed the design was the community's ability to pay, though willingness to pay was checked following the design of the system prior to commencing the construction.

Local Knowledge and Skills

Local knowledge was an important factor in technology choice at Emem. One member of the village was already using a mechanical pump to irrigate his farmland and had a good understanding of how to operate and maintain pumps. This presented an advantage for this technology over others for the design of the water system.

In addition, local knowledge impacted on the design of the water system at Emem in a more subtle way. It was apparent that community members at Emem had existing ways of understanding that gave them an inclination to prefer particular types of technologies over others. For example, when the community was introduced to gravel and slow sand filters they were accepting of the process involved which they perceived to be 'natural' (their choice of word). On the other hand, when the community was introduced to ceramic filters they did not accept the process and asserted that the technology was 'unnatural'.

From a scientific point of view this differentiation of 'natural' and 'unnatural' technologies is quite hard to understand. It proved outside the capacity of the author to understand and predict the features that made a technology 'unnatural'. Perhaps it is the fact that water passes through what appears to be a solid object that the community find objectionable with ceramic filtration.

Social and Cultural Factors

Two examples are presented here, which give details of the way social organisation impacted on the design of the water system at Emem. The first relates to the need to

choose a technology that is appropriate for the social organisation of the village. The second example looks at the overall scheme design employed at Emem and the elements of social organisation that impacted on it.

Example 1: The community at Emem had a strong preference for implementing a single water system that would serve the whole village and could be operated and maintained by a committee made up of representatives from the village. The alternatives would have been to run a single system for the whole village but operate and maintain it as a business, where one person is charged to manage and maintain the systems and who makes an income by selling the water back to the community, or to implement technologies which operate at the household level so that each family is responsible for their own water treatment.

The organisation structure the community preferred mirrored the existing social structures already in place to manage other aspects of community life. Like other communities in the area, Emem is led by a chief and group of elders who are responsible for managing a variety of issues that are of communal concern. For example, during the field work the chief noticed that the paths leading to the village were becoming overgrown and difficult to pass. With the support of the elders he organised for the vegetation to be cut back by allocation of work amongst members of the community. The community recognise the crucial role the chief and elders play in maintaining the village and on the whole are happy to undertake the work as instructed.

The community management of village level water systems proposed by the community was to operate along the same lines. A committee of members of the community, with responsibility delegated from the chief, would organise the village as required to operate and maintain the systems. This may involve collecting money from the community or organising tasks to be carried out as required.

The village-level option selected by the community at Emem requires a high degree of organisation and cohesion from the community. The author felt that the community did exhibit these characteristics and due to the strong preference of the community for this type of management, village level technologies were deemed appropriate. Had this not been the case, it may have been more appropriate to implement solutions at the household level.

Example 2: Inaccessible ground water, high variability of rainfall, and the close proximity of the village to Lake Volta meant that use of surface water was being considered as a technically feasible option right from the early stages of the project. Using water from the lake was only possible, however, if an acceptable route could be found to transmit water from the Lake to the village. Any route from the village to the Lake involved the pipe passing through someone's farm land. It was also inevitable that the village would have to agree on the locations of a limited number of tap stands.

In the end, surface water was employed for the water solution and the pipe passed through farm land belonging to one of the elders, Abraham. He had a lot of land and the financial stability that meant he was not too concerned about small losses of crops. He was the community member with the most experience of using pumps (as he was the only member of the community to use a pump to irrigate his farm land) and as he was the elder in charge of operating and maintaining the pump, having it on his farm land gave him easy access. He would be the one to send members of the community to switch on the pump and having it on his land meant he could give permission to access the pump. The transmission line taken was not the most direct route but these advantages were considered to make the extra expense of additional pipe worth while.

The risk was that because Abraham was a predominant member of the community others would feel that he owned the pump and pipes (see Baptista, 2010).

Consultation with other members of the village indicated that they did not mind, and preferred this to the pipes passing through their own land.

The location that was selected for the tap stands was in the centre of the village in an area near the shop where people congregate. In line with Baptista's findings, the community agreed that this location made it clear that the taps could be used by everyone. There was a general feeling among the village that an advantage of having the tap stand in this location was that there were always people in this area to watch what was happening at the stands. In particular, they could check that the children were not playing with the water or the taps.

Religious Perceptions

Despite various conversations with the community at Emem during the fieldwork about how the water would be extracted from the lake, the issue of using manmade objects to pump water from the lake never seemed to arise. The community did explain that there is a spirit in the water; it is disrespectful to the spirit, for example, for women to enter the water when they are menstruating. But the spirit in the water did not at any point result in any tangible implications for the design of the water and sanitation systems. Despite the author's best efforts to seek out religious implications for design there are no examples that arose during the field work of local belief systems leading to concrete repercussions for the water and sanitation project.

5.5 THE PROJECT AT BAW

5.5.1 Design of the Sanitation Facilities at Baw

The latrines are constructed to a standard dual pit design as shown in figure 5.6 and 5.7. There are three cubicles, one for the girls, one for the boys and one for the teachers. Each contains a reinforced concrete floor with two squat plates but only

one squat plate is in use at any time. Below each squat plate is a pit of three metres depth which is lined with block to contain any faecal pathogens and avoid the pit walls collapsing. When the first pit is full it is closed off and the second pit is used. It takes a few years to fill each pit so by the time the second pit is full the first will have decomposed down and pit one can be used again. In order to minimise unpleasant flies each pit is ventilated and the inside of each cubicle kept quite dark. This means flies fly up the ventilation pipe which allows in the light to attract the flies but has netting over the top to prevent the flies escaping. Eventually, when the flies cannot escape they die and fall into the pit preventing diseases from being spread. The walls of each cubicle are block and the roof is metal sheet.

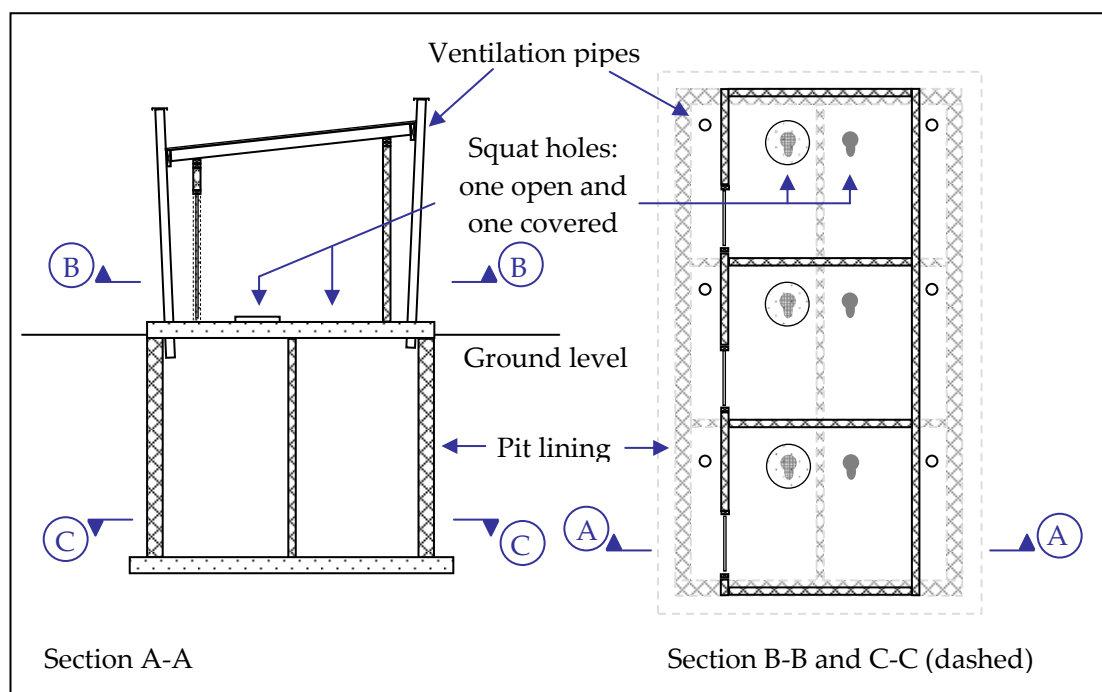


Figure 5.6: Sketch of the toilets at Baw



Figure 5.7: The toilets at Baw

5.5.2 Design Parameters

Technical Factors

As the design is standard the key technical issue for the latrines was finding a suitable location. The toilets had to be located within easy reach of the school but down wind and not too close to the stream where the village collected water during the rainy season. The first location chosen was fine in all these respects but as the community began to dig the pit they quickly hit bedrock. The second location also hit rock but the three metre depth had almost been reached. Therefore the pit walls were raised slightly out of the ground and there is a slight slope up to the toilets where the excavated material was compacted over the original ground level to make up the difference.

Economic Factors

Maintenance costs for the latrines are minimal, as the toilets only require a coat of paint every couple of years for aesthetic reasons, and the intention was for the required finance to come from school fees paid by the parents of the children who attend the school. The ability of the parents to pay school fees was an important

consideration for the project but did not have tangible impact on the design of the school toilets and therefore will not be discussed further here.

Community Development Priorities

The early meetings and informal conversations that took place at Baw identified education as a key concern of many members of the community. A lack of water and sanitation facilities was identified as an issue because the village found that they could not retain Government teachers in the village school because the teachers were used to being able to access these facilities and were not prepared to live and work in a village without access. This impacted on the design as the project became a joint school and sanitation project.

Willingness to Pay

The community were not paying for the construction of the toilets and there is very little by way of maintenance for the toilets. That said, the toilets were being built for a school and there were costs associated with running the school. Without the school the toilets were redundant and so willingness to pay for education became an important consideration for the sustainability of the project. It did not however, have implications for the design of the toilets.

Local Knowledge and Skills

The community's knowledge of the local environment was useful when planning the location of the toilets for the school. Some members of the community helped with an exploration of the local area and contributed their knowledge of water sources and ground conditions.

Social and Cultural Factors and Religious Perceptions

No social or cultural concerns or religious perceptions were identified which were of relevance regarding the use of dual pit ventilated latrines. Squat plates were considered to be sufficient for the children's toilets and had the advantage of being

easy to keep clean. The teachers noted an initial preference for a porcelain seat specially designed for use over a dry pit but decided finally on squat plates following concerns about how to keep the basin clean with a dry system and limited water availability.

5.6 *DISCUSSION*

A limitation of the research is found in the fact that it is not possible to obtain a direct comparison of the long term sustainability of the system implemented and the sustainability that might have been achieved had the design of the system been undertaken without consideration of importance of these qualitative factors. A close comparison may have been possible by implementing a number of water and sanitation systems, half considering qualitative and quantitative factors and half just quantitative, but this would have been unethical.

That said, considering a range of qualitative factors did appear to bring to light a number of factors which had clear implications for the design of the systems. Table 5.1 considers the implications the design parameters identified had for the sustainability of the projects at Emem and Baw.

Design	
Parameter	Possible influence on long term sustainability
Community Development Priorities	<p>In line with Kottak's (1990) conclusions about the nature of community goals, both communities at Emem and Baw had specific priorities for their villages that did not always align with the author's presuppositions. At Emem, the community wanted convenient water (as opposed to better quality). At Baw, the key concern was the children's education, with sanitation as a secondary issue related to this.</p> <p>The scope of both projects increased, with corresponding implications for the design of the systems, so that the projects could truly meet the needs of the community, a key component of sustainable design. Therefore, it seems that community development priorities are an important concern for engineers working on rural water and sanitation projects.</p>
Willingness to Pay	<p>Willingness to pay has clear implications for the long term sustainability of projects as noted by Braimah and Fielmua (2011). However, a problem in the use of 'willingness to pay' was identified during the project at Emem which is likely to limit the usefulness of the parameter during the early phases of the design process. The willingness of the community to pay was dependent upon how beneficial the facilities implemented would be, which was impossible for them to know at the beginning of the design process and difficult until the actual facilities has been constructed.</p>

Table 5.1: The possible influence of design parameters on sustainability (continued on next page)

Design	
Parameter	Possible influence on long term sustainability
Willingness to Pay	It is suggested that ability to pay might be the appropriate design parameter to consider during the first loop of the design cycle.
continued	Once a number of design options have been conceived it may be useful to begin to consider willingness to pay. The engineer would have to find creative ways to describe the likely outcomes for the community to aid the community's ability to define how much they are willing to pay. Willingness to pay can then inform the later stages of the design process.
Local knowledge and skills	<p>At Emem, the choice to use a mechanised pump was informed by the fact that knowledge existed within the community about how to maintain and operate the pump, where to go to buy spare parts etc. Without this it may have been possible to train individuals with this knowledge but this may have been riskier, with a higher chance that the infrastructure would not be sustained.</p> <p>Slow sand filtration was chosen as the technology to treat the water due to the community's perception that this was a 'natural' process. Again, it may have been possible to educate the community, which may have increased their acceptance of other technologies.</p> <p>However, this would have put the acceptance, and therefore sustainability, of the systems at risk which was unnecessary in this instance due as a technically feasible technology existed that was also culturally acceptable.</p>

Table 5.1: The possible influence of design parameters on sustainability (continued from previous page and onto next page)

Design	
Parameter	Possible influence on long term sustainability
Social and cultural factors	<p>At Emem, two examples were given of social factors which could have potentially have impacted on the long term sustainability of the project. In line with the findings of Baptista (2010) the route of the transmission pipe and location of the tap stands in the village was critical to community acceptance of the systems and the perception that the facilities were to be watched over and used by everyone.</p> <p>The importance of utilising existing social structures for the management of systems, which has implications for the overall system design as discussed above, cannot be confirmed by this research but feels intuitively to be important for the sustainability of systems.</p>
Religious perceptions	<p>No evidence was found at either Emem or Baw which can support the findings of Meyer (1999) or Avvannavar and Mani (2008) in the importance of incorporating religious parameters into water and sanitation design for project sustainability.</p>

Table 5.1: The possible influence of design parameters on sustainability (continued from previous page)

The chapter began by looking at the theories of Kottak and Verhelst. Kottak warned of the dangers of ‘over innovating’; implementing development interventions which require communities to adapt more than is necessary to maintain their existing way of life. It could be argued that the desire of the community at Emem to use existing social structures to manage their new infrastructure, which led to the system design being based on village level technologies, is an expression of the community’s resistance to too much change. In this way the findings of this research support Kottak’s theory.

Verhelst claimed that culture is the mechanism by which communities choose whether to accept or reject technologies. Perhaps when the community at Emem asserted that some of the technology options being considered were 'unnatural' they were expressing a cultural discomfort with those technologies. It is impossible to say whether it would have been possible through education to alter the community's opinion of those technologies. However, as more culturally suitable technologies were technically feasible in this case, the likelihood of the systems being used seems greatly increased by selecting one the technologies considered 'natural'.

5.7 WIDER IMPLICATIONS

The chapter has presented two case studies, the water system design at Emem and the sanitation facility design at Baw, in which the implications of design parameters originating in the socio-cultural context for the sustainability of the projects are explored. As with all case studies the question arises as to the extent to which the finding can be generalised to inform other projects of a similar nature.

Not every factor considered turned out to lead to implications for the design of the systems. For example, religious beliefs did not seem to play an important role in the design of the systems at either Emem or Baw and no tangible design implications were identified. It cannot, however, be assumed that this is a result that holds true generally. The next village may take a different view on the use of modern materials in water bodies inhabited by spirits, or there may be entirely different considerations to take into account. It is important to explore this type of issue on a case by case basis. Smith and Ali (2006) provide an example of how water use in the UK can vary considerably depending on the culture and religion of the user.

A number of design parameters were found to impact on the design of the water system at Emem and Baw in a number of specific ways. The engineer in other

regions of Ghana and Africa, or in Asia or South America, may not experience exactly the same issues, but it is supposed that they may have something to gain from the realisation that socio-cultural context is likely to impact on their projects in a way that is broadly similar whilst different in detail.

This chapter has aimed to demonstrate the importance of incorporating socially constructed factors into engineering design through specific case studies. It is the need to include these factors that is thought to be generally true, rather than the specific details of the impacts at the case study. The next chapter goes on to look at the processes that need to be employed to do this effectively.

5.8 CONCLUSIONS

Design parameters for rural water and sanitation projects can arise from the local socio-cultural context in which the projects are being conducted. Consideration of these parameters by the project engineer during the design of systems is likely to lead to the infrastructure implemented being more appropriate for the local context and may increase the chance of the project being sustainable in the long term. Factors which could usefully be considered by engineers as they may reveal important design parameters include, but are not limited to, community development priorities, willingness to pay, local knowledge and skills, social and cultural factors, and religious perceptions of water.

6 Design Process

This chapter is concerned with the implications of socio-cultural context for design process during rural water and sanitation projects. Specifically, the chapter looks at the aspects of design process in which members of beneficiary communities must participate in order to ensure projects are socially and culturally appropriate.

Community participation is known to be an important feature of development projects for a variety of reasons outlined below. Chapter 5 identified a number of design parameters that originate from the socio-cultural contexts in which the case study projects were carried out. These parameters were only identified as the communities participated during the design phase of the projects.

This chapter describes the design process followed during the projects at Emem and Baw and the methods used to engage the communities in the design of their systems. It is found that socio-cultural context has implications not only for design parameters, but also for the engagement processes that are most appropriately applied in order to inform the design process.

It is concluded that if engineers hope to engage a range of different groups from within a community in the engineering design process they must consider the local socio-cultural context and adapt their engagement methods accordingly.

6.1 RESEARCH AIMS

This chapter aims to:

- Discuss the benefits and difficulties of the engagement methods trialled at Emem as perceived by both the author and the community;

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- Explore possible explanations for a number of engagement issues which occurred during the project at Emem; and
 - Consider how engineers can adapt their design process to encourage a range of different groups within beneficiary communities to participate in the design of their systems.

6.2 CHAPTER STRUCTURE

The chapter begins by providing an overview of community participation literature, including an argument as to why participation, which is now firmly established as an important aspect of development projects, is of relevance to engineers. Following this, details of the methods of relevance to this chapter are provided. The middle section of this chapter gives details of the design process employed during the projects at Emem and Baw, along with details of the engagement processes employed, which were considered an integral aspect of the design process.

Results are presented from two sources, firstly themes which come out of the analysis of interviews conducted with the community at Emem are described and secondly examples of engagement issues encountered at Emem are recounted from field records. Discussion turns to the impact of socio-cultural context for engagement process and Hofstede's framework is employed with the goal of understanding how cultural differences between the author and community may have led to some of the issues encountered. Finally, possible implications of socio-cultural context for engineers working on other rural water and sanitation projects are considered.

6.3 LITERATURE

The importance of community participation in development projects has been well established (van Heck, 2003; also see section 2.4.4 of this thesis). An argument is

presented below for the need to engage communities in engineering processes during development projects. Following this, background information on theories of community participation is outlined.

6.3.1 The Need for Community Participation

In developed countries it is possible for consumers to pay very little attention to where water is coming from, how it is treated, or where waste goes. Infrastructure is so extensive and reliable that those who are not scientifically inclined or interested can live with total unawareness of these issues. In rural Africa it is a different story, however. The population usually do not have the luxury of turning on a tap to receive safe drinking water, or a piped sewage system to discretely remove human waste.

The low density of people and economic situation of many regions of the world means that extensive mains systems are not a viable option (Massoud et al, 2009). Decentralised systems, such as wells and bore holes for water provision and pit latrines for sanitation, are a much more practical solution. In other sectors it can be seen that Africa has often bypassed the technologies which require extensive infrastructure and skipped directly to technologies which are less dependent on large scale centralised infrastructure. For example, the telecommunications industry barely touched Africa with landline telephones but with mobile phones achieved widespread success (Vodafone, 2005).

However, decentralised water and sanitation systems can demand much more from their users than centralised systems. Where local authorities and governments are unable to provide services consistently, communities are often left to manage their own infrastructure. They must take ownership of the systems, taking care to protect their water sources from contamination and investing the time, effort and money required to maintain their facilities in the long term. Community managed

decentralised systems require a much greater knowledge and understanding of the underlying principles of science and engineering from users than centralised systems.

In much engineering work in the UK, the engineer is simply providing a service to the consumer. When providing water to a city it probably matters little to most consumers which technology is being used to treat their water, as long as the water arrives in their home consistently and is of a high quality. When problems arise an expert can quickly be on hand to fix the problem. The engineer focuses on the technical aspects of which technology will do the job with the most economic efficiency; most water and sanitation engineers probably never speak directly with the end consumer throughout their entire careers.

When working with rural African communities, however, engagement with the end consumers, the beneficiary community, becomes much more crucial as ultimately the success of the project is dependent upon the community taking ownership of the systems and being able to sustain them (Korten, 1981). Firstly, as was the topic of discussion in the previous chapter, this requires that the communities want to maintain the systems; they must genuinely meet the needs of the community and be designed in accordance with local culture and way of life. Involving the community in the design process is the only way that the critical design parameters discussed in chapter 6 can be identified and incorporated into the design of the systems.

As well as *wanting* to maintain the systems it is important that the community are *able* to maintain the systems; that they have the knowledge and understanding to enable them to do this. Involving the community in every step of the engineering process will increase the likelihood that the community has an understanding of the way the systems have been designed and built that they will need to be able to maintain the systems once the engineer leaves the community.

Community participation is widely acknowledged to be an important component of community development projects, with project failure often attributed to a lack of participation (van Heck, 2003). This chapter looks at the implications of community participation for engineers engaged in rural water and sanitation infrastructure provision.

6.3.2 Background to Community Participation Theory

Broadly speaking there are two divergent streams of thought occupying community participation theory discourse (Morgan, 2001). The first sees issues of power and empowerment as being at the heart of the topic (see for example Campbell and Jovchelovitch, 2000). According to this way of thinking community participation is about empowering communities so that they are able to input into the development plans and projects which will directly affect them.

The level of input by a community on a given project can be classified according to Sherry Arnstein's 'Participation Ladder' (1969), which describes different levels of participation according to the amount of power transferred from the project coordinators to the beneficiaries of the project, the community. At the bottom of the ladder are 'non-participatory' forms of engagement, including 'manipulation' and 'therapy'. Further up the ladder is 'tokenism' including 'informing', 'consultation' and 'placation'. At the top of the ladder is 'citizen power' including 'partnership', 'delegated power' and 'citizen control'.

Power can come from many sources; the most relevant when considering power differentials between community and engineer is knowledge (Long, 1999), due to the engineer's 'expert' status. The concept of 'expert' is a social construct; members of a community of practice agree upon which of its members will be perceived to be an expert and which will not. With regards to development projects the status

arises from an assumption that scientific knowledge is superior to so called 'local' or 'traditional' knowledge (see for example Wall, 2006).

As well as considering power differentials between engineer and community, this school of thought also acknowledges the importance of power differentials between beneficiaries (Dinham, 2005), tackles issues of inclusion (Robertson and Minkler, 1994) and warns against assuming the outwardly perceived group identified as the community will act as a cohesive whole (Dinham, op.cit.).

Paulo Freire is often seen as the 'father of participatory methods for empowerment'. His thinking values local knowledge and emphasises the importance of conscientization, where the oppressed come to understand the structures of power that oppress them through dialogue (Freire, 1971, 1998). Teachers and students are co-learners; knowledge is not the property of the 'experts' to be conveyed to communities (Chitnis, 2005).

The second way of thinking about community participation is more utilitarian in its outlook (Morgan, 2001). In this sense community participation is the means by which projects can better serve the greater good, become more successful for the majority and more sustainable in the long term. For Dudley, "The challenge is now to get beyond the general principle and determine the practicalities of how participation fits into a larger picture of effective aid for just and sustainable development" (Dudley in Morgan, 2001).

As Archon Fung points out, it is not always correct to assume that processes which offer citizens more control are always better or more appropriate (Fung 2006). According to Fung, "One finds few contemporary defenders of that view".

This research is interested in the more practical aspects of community participation and engagement with an overall aim of increasing understanding of how

participation can create more successful and sustainable outcomes for water and sanitation projects to the advantage of beneficiaries. The research looks at participation specifically from the vantage point of engineers involved in rural development projects, considering the need for engineers to engage with local communities for successful project outcomes.

6.4 METHOD

Two methods were employed during research for this chapter. Firstly, informal interview was used to try to understand the community's perspective on the benefits and difficulties of the engagement methods employed. Informal interview was selected as the appropriate method for this task as research was exploratory in nature. The author did not have a strong idea at the outset of the research of the types of issues that the community would raise, but had a sense that it would be beneficial to ask the community about how they had found the engagement process. It was hoped that lessons could be learnt about how engineers could improve the process of community participation.

Due to the informal nature of the interviews and the lack of a set of questions that were asked consistently to all participants findings are limited to the identification of themes that emerged during the interviews. Themes that emerged during initial interviews informed the topics of discussion during subsequent interviews and the questions developed in an organic manner.

Interviews were conducted with 22 people including 2 elders, 6 younger men, 9 women, 2 teenage boys and 3 teenage girls from the community at Emem. Participants were asked to describe their experience of the project at the village and comment on whether they had felt they were able to contribute their ideas to the project, whether they would have liked to contribute more and what stopped them from contributing.

Secondly, examples are provided of issues that occurred related to the participation of the community as perceived by the author. The examples have been selected from field notes made during the project at Emem. Pseudonyms are used throughout to protect the privacy of the individuals referred to.

Comparable data was not collected at Baw for a number of reasons. The author was living at Emem during the final stages of the fieldwork and therefore had many more informal conversations with the community there than the community at Baw. With hind sight, it would have been beneficial to have similar conversations with the community at Baw. However, time pressures were great towards the end of the project and the author's attention was largely focused on completing the projects. No issues were recorded in the field notes that had implications for the engagement process at Baw. The details of the engagement process followed have been included for completeness.

6.5 COMMUNITY PARTICIPATION AT EMEM AND BAW

6.5.1 Design Process at Emem and Baw

Engaging members of the community in the design of water and sanitation systems leads to some inevitable changes to the design process. A typical design process may involve several steps, for example:

1. Define a Problem
2. Brainstorm
3. Generate ideas
4. Identify Criteria and Specify Constraints
5. Explore Possibilities
6. Select an Approach
7. Develop a Proposal

-
8. Make a model or Prototype
 9. Test and Evaluate the Design using Specification
 10. Refine the Design
 11. Create or Make
 12. Processes and Results

This process was adapted to incorporate stakeholder engagement for the projects at Emem and Baw, the design process followed was:

1. Community defines a problem
2. Engineer informs community of technology options available
3. Community identifies criteria and specifies constraints
4. Community explores possibilities with engineer
5. Community and engineer collaborate to select an approach
6. Engineer develops a Proposal
7. Engineer canvasses community opinion on the developed proposal
8. Engineer refines the Design following feedback
9. Community agrees to proceed with design
10. Construction completed
11. Processes and Results assessed according to community's criteria

The process outlined above is not meant to reflect a model design process for engineers working on water and sanitation projects. It is as accurate a reflection as possible of the design process that was actually followed during the projects at Emem and Baw.

It is possible to argue that the process does not in fact go far enough to allow participation during the projects. For example, the author and community collaborated to select the approach that was to be followed and ultimately it was the author who undertook the design work and only consulted with the community.

Whilst the aspirational goal of community empowerment through the transfer of control over design decisions is laudable, it was not the chosen approach. It was felt that by handing over complete power to the community for design decisions there was a risk that only the chief and elders and those with stronger voices would effectively be contributing to the design and that the women and children who would ultimately be affected by the design may not be able to contribute.

A couple of the adjustments made to the design process are likely to be relevant regardless of the exact terms of engagement that the project strives for. Firstly, when engaging non-engineers in the design process it is necessary to include an extra step to provide participants with some basic scientific and engineering awareness. In the case of rural water and sanitation projects this is likely to mean providing information about technology options that are available amongst other things.

At Emem the community had only encountered ground water pump and household rainwater solutions to water provision. At both Emem and Baw the communities had only experienced simple unimproved pit latrines or ventilated improved pit latrines. Rather than brainstorm to generate ideas the onus was on the author to present and inform the communities about potential solutions. Following this the community were able to assess the systems and technology presented by the engineer according to their own criteria and judge potential to help in their own particular context.

It was also found necessary to include an additional step after a design proposal was developed. This step was to canvas opinion on the design from a representative sample of the community. This was particularly necessary at Emem and Baw as the design work had been carried out by the author. Some members of the community were approached by the author and specifically asked to provide comment on the design to ensure that a range of opinions were heard; everyone was

given the opportunity to attend village meetings to give opinion if they wanted. However, even if some members of the community had been involved in the design work, it would still have been necessary to canvass opinion from the rest of the community.

6.5.2 Engagement Process at Emem

Village Survey

The village survey was carried out during the month of July 2010, the key objective was to obtain particular data that it was anticipated in advance would be relevant to the engineering aspects of the project. Table 6.1 gives details of the data gained during the village survey.

Data Gained	Relevant Issue (see 6.3.2 for more details)
Household income	Financial capacity of community and ability to pay
Education levels and skills training	Local knowledge and skills
Population demographic including age, sex, religion and ethnicity	Other design parameters

Table 6.1: Village survey at Emem

Group Discussion Meetings

Group discussion meetings often had dual purpose. They provided an opportunity for the community to discuss their water and sanitation systems as a group and give their opinions on different options. They were also an appropriate forum to reach resolutions and agreement and make the decisions about system design or construction process as required. Table 6.2 gives details of the meetings held at Emem. Figures 6.1 and 6.2 are photographs of group meetings at Emem.

Date	Participants	Purpose	Relevant Issue
07.06.10	Elders	General introductions Discussion of development needs of village Community interest in water and sanitation project	Community development priorities
22.06.10	Whole village	General introductions Scope of project Process Input required from village Discussion of development priorities of village Questions	Community development priorities
29.06.10	Women	Issues of particular concern to women: Their role in village life Development concerns particular to women	Community development priorities
24.08.10	Elders	System options	Financial capacity of the community and ability to pay Design parameters relating to social and cultural factors
28.08.10	Men	System options	
28.08.10	Women	System options	
31.08.10	Elders	System design shown to elders	
31.08.10	Whole village	System design finalised and agreed upon	

Table 6.2: Group discussions at Emem (continued on next page)

Date	Participants	Purpose	Relevant Issue
31.05.11	Women	Problems with system and community management structure	Financial capacity of the community and ability to pay Design parameters relating to social and cultural factors
02.06.11	Whole village	Problems with system and community management structure	

Table 6.2: Group discussions at Emem (continued from previous page)



Figure 6.1: A meeting with the Chief and Elders at Emem

Informal Conversation

Informal conversation was a useful means to reach members of the community who did not feel that they could speak up at group discussion meetings. All the issues discussed during group discussions were discussed with individuals informally before and/or after meetings to ensure that opinions of those who would be unlikely to speak at the meetings were heard.



Figure 6.2: A village meeting at Emem

Village Tours

Village tours were a useful way to get to know the village and the community at the beginning of the project. During village tours members of the community took the author around the village, surrounding farm land and down to the lake. In this way the author gained valuable information about the environment of the area and also became aware of the knowledge the local community held about it. Village tours helped to build bonds between the author and members of the community, with the community seemingly appreciating outside interest in their everyday lives. In addition, it provided an opportunity to speak informally to members of the community who spent more time farming and less time in the village centre.

Presentations and Demonstrations

The engagement methods discussed so far are largely concerned with the transfer of information from community to engineer and the implications this had for the design of the water and sanitation systems at Emem. Conversely, presentations and demonstrations were used where information needed to be transferred from engineer to community. The presentations and demonstrations that were required

at Emem are listed in table 6.3 along with the reason that they were necessary. Full descriptions of the presentations/demonstrations are given following this table.

Presentation / Demonstration	Why it was necessary at Emem
Water cycle and pollution of water resources	To ensure everyone in the community was aware of the link between inadequate sanitation and human health and the need to drink treated water
Water technology options	The community was only familiar with ground water pump technologies and rainwater collection so could not assess the adequacy of other available technologies to meet its needs.
Sanitation technology options	The community was only familiar with pit latrines and ventilated pit latrines so could not assess the adequacy of other available technologies to meet its needs.
Slow sand filtration	This technology was the preferred option following the water technology options workshop so a further workshop was held looking specifically at the maintenance requirements.
Water pumps	Only one member of the community was able to operate a water pump so it was necessary to train further individuals to help run the water system. This was especially important to avoid breaks in the supply of water to the village if the only person able to operate the pump became ill.

Table 6.3: Presentations and demonstrations at Emem (continued on next page)

Presentation / Demonstration	Why it was necessary at Emem
Basic water hydraulics	This workshop was organised so that the community had an understanding of how to arrange the intake pipes between the water and the pump. Due to varying water levels it was felt the community would benefit from being able to lay pipes themselves.

Table 6.3: Presentations and demonstrations at Emem (continued from previous page)

Descriptions of the presentations / demonstrations are given below.

Water Cycle and Pollution of Water Resources

From initial conversation with the community it was apparent that there was good awareness of the link between the lake water they were drinking and illness in the village but there was not a good understanding of the specifics of how water can make you ill. Increasing this consciousness seemed vital to underpin all the other explanations of how technologies could work to provide potable water. A presentation was therefore designed to raise awareness of the concept of bacteria and viruses in water that spread disease.

The difficulty during this presentation was trying to explain that there are things in water which you cannot see. A demonstration was set up where a volunteer was asked to go and stand a distance away from the group at the meeting, she held a book in her hand with a picture drawn on the page. The group had not seen the picture and were asked to describe what they saw. They saw a girl holding a white piece of paper. The group were then shown a pair of binoculars, which they had not seen before. They took it in turns to look at the volunteer through the binoculars and found that they could see a picture on the page that she held. The

point of the exercise was to recognise that things can exist that you cannot see with the naked eye. In other words, it is possible for things to exist in water that you cannot see with the naked eye - you need a microscope to see them.

The demonstration then looked at a sketch of what the lake water looks like if you magnify it. A sample of the water had previously been taken to the local government hospital and sketches made of the community's water through a microscope. The sketches showed high levels of debris and bacteria. Whilst the bilharzia parasite was not seen in the water samples taken to the hospital lab, it is known to be present in the lake water. The community were shown a sketch of the parasite as well and an explanation was given as to the way the parasite spreads disease and the risk factors.

The demonstration finished with discussion of the water cycle focusing on how water sources become contaminated.

The community appeared to the author to be very interested in this presentation. They engaged fully and each member of the village wanted to have a look through the binoculars. The questions asked by the community at the end of the session suggested that they had understood the concepts that were being conveyed and were interested in the health aspects of clean water. For example, many people asked questions about what they could do before the water system was finished to ensure they were drinking healthy water. In response to these questions simple water treatment solutions, such as boiling water, were discussed.

One of the more elderly ladies in the village had poor sight and there was a risk that she felt excluded from this meeting. Care was taken to explain what was happening and what people could see. Further work could usefully consider how engineering presentations and demonstrations could be made more accessible to people with disabilities.

Water Technology Options

Workshops were held where relevant technology options (i.e. those that were considered technically feasible for the community's situation) were presented to the community. At Emem ground water solutions were not possible. Options considered included rainwater collection, household level ceramic filtration and village level slow sand filtration. Following the demonstrations of technologies the community was asked to list the things they liked and disliked about the options.

Slow sand filtration technology was explained using a demonstration utilised by the Edinburgh branch of Engineers without Borders (Engineers without Borders, n.d.). In this demonstration a small amount of clean gravel is put into the bottom of a clear plastic water bottle, which is perforated with a few holes on the base, and clean sand then fills the bottle to about two thirds full. Dirty water is then introduced into the top of the bottle and allowed to slowly filter through the media. As the water drips out of the bottom of the bottle the turbidity can be seen to have reduced dramatically.

The challenge for describing ceramic pot technology was to explain the presence of voids between the particles making up the ceramic pot. Having already discussed the bacteria and viruses that exist in the raw lake water with the community (see above) and looked at the different sizes of these contaminants, it was possible to explain how the ceramic pot filters these out but allows the water to pass through once the community had grasped the concept of pores in the ceramic.

To do this the community took part in a workshop where they looked at grains from the earth and then noted that when compressed the grains made what looked like a solid material. The community then looked at a drawing of the particles making the solid material and agreed that due to the shape of the particles there must also be air gaps in the material. The size of the voids was then discussed compared to the size

of bacteria and viruses and sketches drawn of the clay pot and contaminated water at microscopic scale.

From the previous workshop looking at the water cycle and contamination of water sources the community had gained an understanding of why rainwater is often a good source of high quality water. Some members of the community had metal roofs and others were considering upgrading their thatch roofs to metal which made rainwater collection an option for those families. Some families in the village were already collecting rainwater for drinking, and those with few members were able to collect and store water for the majority of the year due to the two rainy seasons of this area. During the workshop the advantages and disadvantages of rainwater collection for the village were also discussed.

Sanitation Technology Options

The community were shown pictures of different types of sanitation technologies and discussion took place of the differences between technology options. The community were asked to list what they liked and disliked about the different options.

Water Pumps

The member of the community who was able to operate the pump led a workshop teaching other members of the community how to operate it. Community members were selected during a group meeting for this job and included women and individuals from different families.

Basic Water Hydraulics

This demonstration consisted of using a 20 litre water container with a clear pipe (a camping shower) to represent the lake and the pipe to the pump. The community observed that the water level remained the same throughout the pipe and bag. Water only flowed through the pipe and out when every part of the pipe remained

below the water level in the bag. In this way issues associated with airlocks in the pump intake were explained.

6.5.3 Engagement Process at Baw

The project at Baw started a few months after the project had begun at Emem. During the early stages of engagement at Emem several issues had arisen. In particular it was felt that the prolonged discussions prior to commencing construction had led to a loss of confidence of the community in the project. After a few initial visits to the community at Baw it was clear that the community's primary interest was the school building and so relatively early on in the project a truck load of blocks to repair the school walls and timbers to repair the sagging roof were sent to the project in a gesture that was supposed to make the statement, "we mean business!"

Time pressures were much greater on the project at Baw than had been experienced at Emem. The other key difference with the project at Emem was the initial focus on sanitation at Baw, where the focus had been on water provision at Emem.

Group Discussion Meetings

Group discussions were often less well attended at Baw than at Emem. Whole village meetings were usually attended only by the chief, elders and those more engaged in community life in the village. Other methods were employed to try and reach those members of the community who did not attend group meetings. Table 6.4 gives details of the group discussion meetings that took place at Baw. Figure 6.3 is a photograph taken at one of the village meetings at Baw.

Date	Participants	Purpose	Relevant Issue
10.09.10	Chief and elders	Follow local customs and greet chief on first arrival to a new village. Discuss development priorities of the village. In the case of the project at Baw a member of a nearby community had requested the project and set up the first meeting.	Community Priorities
01.10.10	Whole village meeting	Introductions to whole community, discuss community development priorities and proposal to repair school and build sanitation facilities, reach consensus regarding whether there is a need for a local teacher to be paid for by the community and when and how much parents need to pay, outline input required from community and that of project coordinators.	Community Priorities Financial capacity and willingness to pay Local knowledge and skills Labour contributions from the community Other design parameters
08.10.10	Whole village meeting	Plan schedule for latrine construction, discuss progress regarding Government's agreement to send teachers, continued discussion of payment plan	Financial capacity and willingness to pay

Table 6.4: Group discussions at Baw (continued on next page)

Date	Participants	Purpose	Relevant Issue
18.10.10	Meeting with parents and teachers	Discussion of the type of technology to be selected for the toilets. The community were familiar with pit latrines so this meeting really involved allowing to community to raise any concerns about this type of technology and discussion about the type of seat or squat plate that would be best for the children.	Social and cultural parameters Other design parameters
09.12.10	Meeting with teachers	Once Government teachers had been assigned to the school a meeting was held to discuss concerns specific to them. There was no set agenda for this meeting other than identifying the teachers concerns that might make them less willing to continue their work at the school.	Teacher priorities

Table 6.4: Group discussions at Baw (continued from previous page)



Figure 6.3: A village meeting at Baw

Informal Conversation

Informal conversation was important at Baw due to the low attendance of many members of the community to the whole village meetings. With less rapport built between author and community however, the community were less forthcoming than had been the case at Emem. Many members of the community appeared quite complacent to the development initiative and unconvinced that any real benefits could be brought through it. In the end informal conversation was used to give members of the community the opportunity to contribute ideas but many chose not to engage in the project.

Village Tours

Village tours were used as a way to get to know the village, understand the environment and meet a greater proportion of the community. Village tours were also used to identify suitable locations for the school toilets as in this way it was possible to include the village and use their knowledge of the local environment.



Figure 6.4: Interactive river model demonstration at the school at Baw

Interactive River Model Demonstration

To demonstrate the importance of using a proper latrine facility an interactive river model demonstration created by Inglesfield and Stallwood (2011) was utilised. The demonstration was carried out in the school prior to opening the toilets to encourage the children to use their new latrines. Figure 6.4 is a photograph of the Interactive river model demonstration taking place at the school in Baw.

6.6 COMMUNITY PERCEPTIONS OF THE ENGAGEMENT PROCESS AT EMEM

The following themes emerged from interviews with members of the community at Emem about the engagement process followed during the project.

6.6.1 'Who Can Speak?'

One of the Key themes emerging from interviews held with the community about the benefits and difficulties of the different engagement methods was 'who could speak'. Individuals held many different perspectives about who was able to speak in different social situations. Factors influencing whether community members could speak up were:

- The status of the individual
- The status of the other individuals involved in the meeting
- Previous experience of speaking in public
- Strength of personality
- Strength of opinion regarding the topic being discussed
- Whether or not others had already spoken on the topic
- Beliefs about personal role in society, e.g. whether women should be involved in decision making processes

The majority of the women interviewed felt that they were unable to speak during whole village meetings. One woman said that she preferred the men to take the decisions for the village as, "the bible tells you to bow down to men". All the other women preferred to be able to share their opinions but either felt that the men would not like them to speak or felt too shy and unable to speak. A few women described how some of the women had never learnt to speak in public. The minority of women who did feel they could speak at the village meetings spoke of the way that they had learnt to talk in public, by being around other women who could talk in public. One woman spoke of the way the other women in the village called her, 'Madam Speaker' because she was always the one who could talk at the village meetings.

Many of the interview participants spoke of difficulty in speaking after the elders had spoken if they disagreed with the ideas of the elders. Some of the younger men described the way that they were expected by custom to say that the elders must speak first at village meetings but then felt that they could not say anything to contradict the elders afterwards. One of the ladies interviewed said that if the chief or elders said something she disagreed with at a village meeting, she could not disagree but would just leave the meeting. Many of the women said that they often felt uncomfortable disagreeing with the ideas of others in any context.

Having a strong personality or believing an issue was very important, however, were factors that many of the interview participants thought would make individuals more likely to speak up at village meetings, regardless of age or sex. One young man aged twenty-two spoke of his experience when he felt the chief and elders had a bad idea. He did not feel that he could speak up at the village meeting but went to speak to the chief in private after the meeting. In this context he said the chief "listened well". He said that you can only go and speak to the elders if you are strong, many would not do this. Another younger man aged in his mid-thirties said

that sometimes you have to disagree with the elders: "If they bring an idea that you know will never work, we have to disagree".

The women and younger men all agreed that they could speak in family meetings. One woman felt that she could speak but ultimately did not think that the family would change their actions based on her opinion. In general the women, young men and teenage boys felt that the family group discussion was the forum where they would be most able to have their say. The teenage boys said that they would like to be more involved in the decision making process in their village and they could do this at family meetings but not at village meetings. One idea from the community was to hold family meetings first and then bring all the ideas of the families together in a whole village meeting.

The only group who did not feel like they could speak at family meetings was the young girls. All three girls interviewed, aged twelve, twelve and fourteen, said they could not attend village meetings because they were always at school but they were able to attend family meetings. Though they were able to attend they did not feel that they were able to speak. They preferred to be asked questions in small groups of girls of a similar age so that they did not feel shy.

The two elders interviewed expressed concern about holding group discussions without allowing the whole village to attend. They were worried that members of the community not involved in the meeting may think that they were not being included in the plan. They described the process of village meetings, saying that they brought the topic for the meeting so must speak first. The elders then listen to everyone's opinions, including the women. He felt that the women were not or should not be afraid to speak out. He did worry that those who don't speak may go home and discuss their different ideas amongst themselves.

6.6.2 'Knowing What's Happening'

The other key theme that came from the interviews was the ability of the engagement methods to ensure that everyone in the village had knowledge of what was happening in the village with the project. In this sense village meetings were popular as a way of getting information to as many people as possible at one time. Some people interviewed complained that they had had to travel or had other commitments and had therefore been unable to attend some of the meetings and did not have a full understanding of what was happening.

A few participants talked of knowing what is happening as being important so that they could put forward their ideas if they disagreed with any of the decisions being taken. One lady said that if her opinion is different from the elders she would not go to the elders but did feel she could speak to the author.

One woman complained that as it was largely the men involved in the construction, they were making a number of decisions without consulting the women who would be affected most by the decisions they took. Another lady said that she had often had questions she wanted to ask about what was happening but could not unless the project translator was around as she did not have good English.

6.7 *AUTHOR'S PERCEPTIONS OF THE ENGAGEMENT PROCESS AT EMEM*

During the project at Emem a number of issues were perceived by the author during the participation process. Examples of events recorded in the field notes are provided below. Pseudo names are used throughout the examples.

Example 1: "Whatever you think"

The author approached the project at Emem with the opinion that she was working on behalf of the community who ought to lead the development process in their own community. The community, according to the author's preconceptions, should provide their opinions about a wide range of topics including the water and sanitation system design, the project process and any other aspects about which the community had a view. There was a noticeable reticence, however, on the part of most of the community to voice their opinions. Throughout the project, "Whatever you think" was a response heard time and time again to the engineer's questions. The chief and elders on the other hand had no such inhibitions and were very happy to voice their opinions. The author could not understand why the ordinary members of the community did not want to be more involved in the project.

Example 2: "My mother has already spoken"

During the project it was observed that when individuals did give opinions they did not want to disagree with the opinions that others had given. During an informal conversation with two women about what meetings needed to be scheduled the elder woman, Amma, was predominantly speaking and presenting what the author presumed to be her own opinion that it would be better to have a few family meetings rather than one big village meeting. The engineer then asked the younger women, Yaa, for her opinions, assuming that Yaa would have her own, possibly different, opinion. Yaa looked confused and said, "My mother has already spoken". It appeared strange from the engineer's perspective that Yaa would not give her opinion, even though it may be beneficial to the project.

Example 3: For the greater good

In another case, the author was specifically looking for a personal opinion from a woman called Adzoa, who had trouble walking. She was the only lady in the village who had this particular issue and her input into the design of the water and sanitation systems to make it easier for her to collect water or use the latrines was

sought. Adzoa's opinion, however, was not forthcoming as she did not feel that her own wellbeing was important when the majority of the group did not have her problem. In a group meeting with several women to discuss how the water collection point should be designed, another woman suggested making the approach as flat as possible to help Adzoa collect her water a little bit more easily. When the rest of the community cared about the Adzoa's wellbeing, it seemed odd that she would not contribute her opinion regarding how to design the systems to allow her ease of access.

6.8 *DISCUSSION*

Reed and Smout (2005) warn of the importance of including a broad range of groups within a community in water and sanitation infrastructure development to ensure that projects do not only benefit a small majority but bring benefits to the majority. Both of the themes identified from the interviews with the community at Emem, and examples 1 to 3 above, have implications for whose voice will be heard during projects. Usually the chief and elders were more forthcoming with ideas and opinions and this led to a risk that the systems were designed according to only their preferences.

Notably, the chief and elders are male and older. Water collection is often carried out by the women and younger members of the community. As far as sanitation is concerned, younger members of the community and women have different problems to face from the older men. This raised the problem that the chief and elders, while having the best intentions for the project, would not have full understanding of the issues faced by the women and children.

The interviews revealed that different members of the community feel able to give their opinions in different circumstances. The chief and elders prefer whole village meetings to appear more democratic and avoid the appearance of taking village

decisions without consultation with the rest of the community. Others did not feel able to take part in whole village meetings, however, especially the younger individuals and the women.

The implication of this is that engineers are likely to have to plan a range of engagement methods to ensure as many people as possible are able to give their opinions. In addition, these themes suggest that engineers need to think carefully about the group dynamics that exist in group meetings and the implications this has on whose opinions will be given and who will not feel able to speak.

The suggestion that some members of the community at Emem did not feel that they always knew what was happening on the project indicates the attention that engineers need to pay to ensuring communication systems are effective during projects. This is made more difficult by a lack of communication technology and low levels of literacy but is vital as if people do not understand what is happening they are unable to speak up when they feel something is inappropriate for them or their village. Ineffective communication means an opportunity to avoid the pitfalls of inappropriate decisions is lost.

6.8.1 Insights from Hofstede's Model of Culture

This section turns to the theories of Hofstede (1980, 1991; Hofstede et al., 2010; see also chapter 3 of this thesis); two of his dimensions 'power distance index' and 'individualism versus collectivism' seem to offer particular insights into the issues encountered during the projects.

Power Distance Index

The community belong to a culture which scores high on Hofstede's power distance index. According to Hofstede, subordinates in cultures with high power distance scores are accustomed to being told what to do and are less familiar with the more

democratic ways of working that are commonplace in cultures with smaller power distances (Hofstede et al., 2010 pp73-74). Conversely the author belongs to a culture with a low power distance index and is used to flatter structures of power where subordinates and authority work together on more equal terms and subordinates expect to be consulted.

Perhaps this explains the reticence of the community to give their opinions about particular topics and leads them to respond, "Whatever you think", as described in example 1. It is not a sign of uninterest in the project but rather the community do not feel it is their role to provide opinions.

This dimension could also explain why 'who was present' at different meeting had such an impact on who was able to speak, as was found through the interviews with the community at Emem. The women, who did not feel able to speak at the village meetings, often could at a family meeting. The younger girls were really only able to speak in small groups of other small girls. The high score of Ghana on the 'power distance index' seems to lead to those of a lower status being unlikely to give opinions when others of a higher status are present.

Hofstede notes a paradox with regards to participation in cultures that score highly for PDI. Participation calls for redistribution of power and is therefore not compatible with high PDI cultures. Dorsner (2007) makes the interesting point that, "If community development practitioners have failed to come to terms with the limitations of participation, it may be precisely because these limitations are natural outcomes of any non-coerced society where choice and freedom are in action". In other words, development practitioners may need to accept that individuals may choose not to participate. She suggests making sure that no one is excluded from being able to participate but accepting that some will choose not to.

Individualism versus Collectivism

The community also belongs to a culture which is much more collectively orientated than the author's individualist culture. Collectivist cultures tend to present the opinions of their group rather than their own personal opinion, with the word 'I' used much less than in individualist cultures (ibid pp112-117). Initially the author had not realized that often views being presented were those of a group and not of the individual speaking. It is likely that Amma in example 2 was presenting the opinion of the group to the engineer. Therefore, when Yaa was asked for her opinion this appeared a strange request from her cultural perspective. Amma had given the group opinion and therefore there was no need for her to reiterate it, her mother had already spoken.

It is possible that similar reasons led to Adzoa in example 3 being reticent to share opinions about her own well being. As the majority of the group did not have her problem she perhaps did not feel that it was for the benefit of the group to design the systems with her individual problems in mind. The group however, were happy to look out for the all their members and so brought up the issue of ease of access on behalf of Adzoa.

This indicates that asking members of a collective community to comment on specific design features of systems from the point of view of others in the community may be more effective than asking members to speak on behalf of themselves, though it is noted that personalities are varied. Some members of the community at Emem would be more than happy to speak on their own behalf.

6.8.2 Implications for Engineers

The findings of this chapter seem to have several implications for engineers working on water and sanitation projects in developing countries. Firstly, it seems that engineers may need to acknowledge that participation, whilst important for the

sustainability of projects, is particularly difficult in cultures with high power distances in their social structures. Overcoming this challenge will require engineers to plan their community engagement with a great deal of thought and care.

If, like at Emem, different members of the community are able to contribute ideas when different groups of people are present, it will be necessary to think carefully about the people invited to group discussions and a number of different discussions with different groups may be necessary.

If, like at Emem, the community has collective, rather than individualist, tendencies, it may be better to ask how the systems can be designed to suit the village as a whole rather than for their own personal preferences.

Finally, engineers need to take great care about the communication processes they implement during projects. This can be difficult and in some cases may involve ensuring messages are passed by word of mouth if other methods of communication are not available. However, ensuring everyone knows what is happening provides a last opportunity for individuals or communities to highlight design issues which may be critical for the long term sustainability of systems.

6.9 OTHER ISSUES ENCOUNTERED DURING THE ENGAGEMENT PROCESS

This section presents some reflections of further issues that arose during the fieldwork of relevance to community participation.

6.9.1 Translation Issues

Translation issues were expected to be encountered during the projects and despite the author's best efforts to mitigate translation problems a few concerns did arise.

During the fieldwork several examples arose of words and concepts which were difficult to translate into the local language. In a pilot survey at Emem, members of the community were asked whether they felt they had a right to access to water and sanitation facilities. The concept of human rights is one which is widely understood and does not need explanation in the West. In Ewe culture and language, there does not seem to be any such equivalent word or concept. It is surprisingly difficult to explain and impossible to know whether the explanation is being interpreted in the intended way.

Technical words proved equally challenging to translate. There are no words for microscope or magnification in the Ewe language for example. This proved challenging during the demonstration of the bacteria present in the community water supply. Bulkheads became "tank connectors" and the word "machine" had to suffice as the name for the water pump. Using the word "machine" seemed to mystify how the pump was working and the explanatory power of the word "pump" was lost.

Specific words can easily cause confusion and inconsistency in responses to questions asked to communities. For example, whilst undertaking the census and collecting basic demographic data about Emem, members of the community were asked what languages they spoke. Unbeknown to the author, there is a distinction made by the community about languages that are understood and languages that are spoken. Having found out that some members of the community spoke Ewe, some Twi and a few Adangbe, the author proceeded to ensure in the initial village meeting that everything was repeated in three languages. It was only later it

transpired that this was a waste of precious research funding because everyone in the village could understand Ewe, even if they chose to speak Twi or Adangbe. This mistake was mitigated by the thought that perhaps repeating everything in three languages through two translators was no bad thing, perhaps something that was unclear in one language became transparent in another.

6.9.2 Practical Communication Issues

There were some practical issues encountered that made efficient communication more challenging. It was difficult to find a way to get a message reliably to everyone in the community, for example when organising a village meeting. With no communication media such as mobile phones or email and with low levels of literacy in the community it was necessary to walk up and down the village telling individuals about the meetings and asking them to spread the word. This proved to be a time consuming and unreliable method of communication.

6.10 CONCLUSIONS

The general conclusion of this chapter is that, if engineers wish to engage a range of different groups from within a community in the engineering design process they must consider the local socio-cultural context and adapt their engagement methods accordingly. Failure to do this may result in some members of the beneficiary community not engaging in the project fully which may have implications for the long term sustainability of the project.

It is also important to ensure effective communication methods are in place so that everyone in the community is aware of what is happening with the project. This is as much about giving people the opportunity to speak up if they disagree with project designs as anything else.

The specific conclusions of this chapter are that:

For cultures which have a large power distance, participation is likely to be particularly difficult and therefore engagement methods will require a degree of care from engineers. In particular, it may be beneficial in this context to consider group dynamic which may result in the most effective design process being to conduct a number of different group discussions to maximise the number of people who feel able to contribute opinions.

For cultures that are more collectively orientated, it may be advantageous to phrase design questions in terms of what would suit the whole community better, rather than asking for individual perspectives.

7 Construction Management

This chapter is concerned with the implications of cultural context for the management of water and sanitation projects in developing countries during the construction phase. Several issues were encountered during the projects at Emem and Baw that arose when the author managed the projects in a way that was inappropriate for the local context. Some of the issues encountered had the potential to prevent the infrastructure from being completed and therefore understanding how to manage projects more effectively for the local social and cultural context is seen as critical to the sustainability of the projects in the long term. In addition, effective project management has implications for quality control, and the likelihood of acceptance and ownership of the systems by the local community.

7.1 *RESEARCH AIMS*

This chapter aims to:

- Explore the socio-cultural causes of a number of issues that occurred during the projects at Emem and Baw; and
- Consider how these types of issues could be avoided during other similar construction projects by adapting management strategy to the local socio-cultural context.

7.2 *CHAPTER STRUCTURE*

A brief overview of the relevance of socio-cultural context to construction management as highlighted in the literature is first presented. Following this, the project management issues experienced during the case study projects at Emem and Baw are described and then examined through the lens of various theories of

culture. The consequence of the main finding, that cultural differences impacted on the work of the engineer by creating issues relating to management structure, sequencing of construction activities and quality control, will be discussed specifically for the case study projects, and also in a broader and more generic context.

7.3 LITERATURE

7.3.1 Cross-Cultural Management

The difficulties of cross-cultural project management have been well documented. Enshassi and Burgess (1991) found that construction managers working in cross-cultural contexts needed to have a strong awareness of cultural differences and be able to adapt their managerial style in order to work effectively when managing a multi-cultural work force. Rabbat and Harris (1982) studied international construction firms operating in the Middle East and raised the issue of the need for managers to adapt to the local culture in order to reduce conflict and lessen the implications of conflict on project outcomes. English (2002) documented the way that different cultural perspectives can lead to difficulties with effective communication whilst studying cross-cultural communication of construction workers in South Africa.

Even within regions cultural differences can cause issues for project management. Low and Shi (2001) looked at Singaporean firms working in China and found that, "Mismanaging cultural differences can render otherwise successful managers and organizations ineffective and frustrated when working across cultures".

7.4 CONSTRUCTION MANAGEMENT ISSUES EXPERIENCED

7.4.1 Examples from Emem and Baw

A number of misunderstandings between engineer and community occurred during the projects at Emem and Baw, which caused great frustration and confusion.

Example 1: When the Chief's away...

Initially during the project at Emem it seemed easy to organise the work schedule and progress was good. Many of the members of the community were helping on the project, even on days that were not designated communal labour days.

However, towards the end of the construction work the chief lost interest in the project temporarily. His mother had died and his attentions were turned towards planning her funeral and he had acquired a girlfriend in a neighbouring village and seemed more interested in visiting her than attending to his village duties. Of course there was a period of time following the funeral where work had to stop to allow the village to mourn the loss of a well respected elder, but when members of the village started to return to work it was considered an appropriate time to continue work on the project.

At this point the engineer had a limited time period remaining on the project and pressure was mounting to complete the project. There were clearly defined jobs that needed to be done and the engineer set about negotiating with individuals about who would do what to get the project completed. But at this late stage in the project the community appeared complacent to organise themselves to work. The engineer could not understand the lethargy apparent in the community; it seemed as though everyone had given up on the project as work rapidly fell behind schedule.

This had serious implications for the project. Construction never began on the planned pit latrines as the final work on the water system continued so slowly that it was only just completed before the author had to fly back to the UK.

Example 2: Ghana Time

Timekeeping was a constant source of frustration for the author during the projects at both Emem and Baw. To the author's mind the locals appeared uncommitted to the projects and their relaxed attitude to timekeeping was a constant source of tension.

Organising the working day proved to be stressful during the project work. During the rainy season access to the site was not possible by road, and it was necessary to take a boat to reach the village. As this was reasonably expensive it was preferred that everyone going to the site met so that only one journey was necessary. Coordinating the collection of skilled labourers and translators was often very frustrating. Similarly when using local taxis, it was normal for them to arrive hours late or to take the project team on a half-hour detour during the journey so that the driver could accomplish another task.

That is not to say that local concepts of time did not provide benefits for the project. The local attitude towards making time to help others was incredibly refreshing. It was never felt that someone was rushing off to their next scheduled appointment and did not have time to talk. During the project a plumber was consulted to help with some of the practical details and he helped to purchase the required pipes and spent several days on the site helping with the construction. It was only later realised that he was due to travel to Accra to work on another job and that that had been set back by several days because of his assistance to the project at Emem. There was not one occasion during the project when a paid worker complained that they had worked too many hours or that they needed to leave early to get to another appointment.

There were of course exceptions to this generalisation found during the fieldwork. The mason who worked on the project was frequently half an hour early for work in the morning, and there were some taxi drivers who were more accustomed to working with obrunis (the white people). As the project progressed this issue became less problematic, as the author found more local people who could bend to her own way of viewing time.

Example 3: Near or Far

If you ask someone how far to the next village in the UK, you are likely to receive an answer along the lines of, 'five minutes drive' or 'about ten kilometres'. In Ghana, the only response you are likely to get is either, 'near' or 'far'.

Both projects involved construction where measurement was necessary. At Emem, the transmission pipe needed to be laid to a particular depth, especially where the pipe passed under a track along which cars occasionally drove. At Baw, the toilets had been designed with particular dimensions in mind, and the intention that the wall of the superstructure sit directly over the walls that divide the pits below. The lack of attention to measuring dimensions was a source of frustration for the author, it felt as though every time she turned her back for a minute the local workforce returned to judging distances very roughly by eye.

Figure 7.1 shows a photograph of the toilets at Baw. The irregular spacing of the latrine doors reveals the relaxed approach to measuring dimensions taken by the project mason.



Figure 7.1: The latrines at Baw

Example 4: Money Matters

The danger of mismanaging rural water and sanitation projects can perhaps be illustrated with the following account, where important social factors that should have become apparent through stakeholder engagement were missed leading to unnecessary hurdles and barriers to effective engineer / community relations:

The community at Baw had agreed that they would contribute to the school toilet building project by digging the pit that would be required before construction would begin. This was clearly a big undertaking for the community. The author knew that the community had labour days on Tuesdays and Sundays and due to time pressures it would be necessary to work on more than just communal labour days. On the Sunday the community worked and began to build the pits, with many members of the community working on a rotational basis.

The next day (which was a Monday and not a communal labour day), the author was only able to stay at the project for a few hours at the beginning of the day before being called away to duties at Emem. She did not want the project Mason to be left working alone for health and safety reasons. Only a few members of the community were around at the time as the majority were working on their farms, so

these individuals were asked to work on the toilets in return for five cedis payment for the days work.

On the Tuesday those members who worked so hard on the Sunday refused to work on the toilet project. It was clear that they were angry with the author and that some faux pas had been made but the author did not understand exactly what she had done.

7.5 DISCUSSION

To the foreign engineer these issues seemed perplexing. Why was the community so reticent to give their opinions? Why can two individuals not have their own different perspectives or speak up for their own needs? Why would the whole community put down their tools as soon as the chief turns his back on the project or the mason put down his tape measure as soon as the engineer looks the other way? The following paragraphs explore whether the use of Hofstede's cultural dimensions can elucidate any understanding of these events.

7.5.1 Insights from Hofstede's Model of Culture

Power Distance Index and Uncertainty Avoidance Index

Hofstede identifies four classifications in the way that different cultures structure their organisations. These classifications are based on the cultural dimensions of power distance index and uncertainty avoidance index (ibid p303). The community, coming from a culture with a high power distance index and a low uncertainty avoidance index would tend to organise themselves naturally into a structure that operates a bit like an 'extended family'. In the community at Emem the 'grandfather' of the family is the chief, he is the central authority and his role is to listen to the rest of the family but the responsibility falls to him to decide on the best course of action to take.

The engineer, by contrast, comes from a culture with low power distance and low uncertainty avoidance which tends towards structures that work like a village market. In the village market model members of the organisation are required to negotiate with others in the organisation to come to an agreed course of action. In example 4 the engineer assumed that it would be possible to negotiate with members of the community in order to complete the project without the presence of the chief and was therefore confused by the inaction of members of the community, thinking their lack of action represented a lack of interest in the project.

The use of Hofstede's framework provides an alternative explanation for the community's inaction, however. As the community operate like an 'extended family', a family in which the engineer does not belong, the engineer has no authority to ask people in the village to do any work. Work cannot be negotiated like in the 'village market'.

In addition, the chief's lack of interest meant that a key motivational factor was lost for the community. Motivation for many individuals who come from countries with high PDI and low UAI comes from the 'master' (Hofstede, 2010 p328). The 'master' being a figure with, "power based on tradition and charisma" in comparison to the 'boss' who would be a motivator for cultures with high PDI and high UAI. For countries such as Great Britain, with low PDI and low UAI, a 'boss' or 'master' cannot motivate positively but can be the cause of negative motivation (Herzberg, 1959 in Hofstede, *ibid* p327).

The conclusion is that the importance of culture cannot be underestimated in planning project management of community development projects. Buy in from the 'master' or 'boss' of high PDI cultures is of critical importance for project success. It is unlikely that a project can be successful if this is not achieved.

7.5.2 Insights from other theories

Concepts of Time

Issues often arose during the project at Emem that can be attributed to differing concepts of time held between the engineer and community. Hofstede's theory would suggest that as Ghana is less comfortable with uncertainty than Great Britain, Ghanaians ought to be more time conscious. This proved not to be the case, however. The differing values and behaviours of the engineer and community can be explained by consideration of the alternative theories discussed above. The engineer was working to what Hall (1983) would call a monochromatic conception of time or Trompenaars (1997) would call 'time as sequence'; the community was working to what Hall (ob cit) would call a polychromatic conception or Trompenaars (ob cit) 'time as synchronisation'. By the Ghanaian way of thinking relationships are more important than tasks and therefore it would be unheard of to rush an interaction with a friend or colleague with the goal of achieving a task, or arriving at work, by a specified time. Trompenaars categorisation of Ghanaian time keeping as 'time as synchronisation' may also explain why taxi drivers and local passengers did not mind taking long detours to accomplish tasks unrelated to the project, which was difficult to understand from the author's perspective of 'time as sequence', which leads to the belief that one task should be accomplished before proceeding to the next.

Mayers and Ligenfelter's theory suggests that time passes only once an event is complete rather than regularly according to a clock. This could explain why the plumber in example 5 stayed to finish a job delaying a trip to Accra without complaint. By his way of thinking the job in Accra started after completion of the author's job, not at any time specified by a clock.

Concepts of Space

During the fieldwork, it became clear that local and foreign concepts of space also differed significantly. The Ghanaian disinterest in exact distances and measurements seems to correspond to Hall's explanation of the way cultures with 'low territoriality' are generally less aware of space.

7.5.3 Other Explanations

The events of example 4 occurred at Baw on a day when the author did not have a translator present, the mason who was working on the project had been the only person on site fluent in both English and Twi. The author returned later with a translator to try to understand the events that had led to the community refusing to work on the project on their communal labour day.

In many of the villages in the area, including the village of Emem, the chief will make a law that everyone in the village must work on communal labour days. The laws are recognised by the community and there are penalties applied to those who break the laws. The author knew that communal labour was conducted at Baw but had not realised that not every chief implements a law that requires compliance or enforces laws with penalties.

Unfortunately, the chief of Baw had not made communal labour a law. It turned out that many of the community held the view that communal labour should be a requirement and should be enforced by a local law. They continued to work on labour days out of principle rather than due to a strict requirement placed on them to do so. Even more unfortunately, the individuals asked to work on the project on the Monday regularly opt out of communal labour and had not worked on the Sunday. It is completely understandable therefore that some members of the community felt angered as they had worked for free when others had been paid for essentially the same work.

The matter was eventually resolved but proved costly in the end. Only members of the village who worked on both communal labour days of the week were eligible for paid work during the remainder of the week. At times more members of the community were working on the project on non-labour days than were strictly required to ensure everyone had the chance to earn the days salary.

7.5.4 Implications for Engineers

Considering the above examples of the cultural misunderstandings that occurred at Emem and Baw suggests implications for engineers working on community based projects in developing countries.

Management Structure

At the case study project the management structure applied by the engineer, based on assumptions about how organisations should work which originated in the engineers cultural background, proved ineffective. It was not possible to negotiate directly with members of the community in order to organise work; all work had to be organised through a leader of the community. When the chief was away it would perhaps been more effective to turn to the next most senior member of the community and ask him to organise the community to work on the project, rather than speaking directly to the community.

Like Low and Shi (2001) it was found that a lack of understanding of the local culture led to an inability to motivate individuals to work. Findings also support Enshassi and Burgess (1991) and Rabbat and Harris (1982) as misunderstanding the local cultural context was found to impact on the ability of the project manager to manage the local workforce effectively. Understanding the local culture better would have made selecting an appropriate management structure possible.

Management Highly Localised

The author, in example 4, made the mistake of making an assumption about the community at Baw, following experience of a similar issue at Emem. Whilst communal labour was carried out at both communities, a local law was not in place at Baw whilst it was at Emem. This example illustrates the importance of understanding the socio-cultural context on a very local basis and the need to consider the uniqueness of each community in which a project is conducted. As was found by Rabbat and Harris (1982), failure to do this effectively can result in conflict.

Where Money is Involved, Great Caution is Required

The author's experience of living and working in Ghana was that local communities were incredibly tolerant of her cultural ignorance and constant social faux pas. The exception, as illustrated by example 4 above, was where money was involved. A cultural slip-up involving money proved much harder to overcome and put the whole project at risk.

It may be best to avoid paying beneficiary community members for any aspect of work, though where this is necessary it is vital that local socio-cultural context is thoroughly understood and an arrangement is made that is perceived by fair as all involved. Setting the wage paid as close as possible to the expected income of a days work fishing or farming (depending on the local skill) may serve to ensure individuals are neither advantaged or disadvantaged by working on the project and thereby sensitivity may be reduced regarding who is and is not employed by the project.

Construction Sequencing

The differing concepts of time held by the author from the community had implications for sequencing of the sequencing of construction activities and the ability of the author to keep the project to a planned programme of work. From the

author's cultural perspective it is difficult to justify the additional costs that seemed to be incurred due to persistent lateness and the main coping mechanism employed was to ask those involved on the project be at meeting points a number of hours prior to the time they were actually required.

That is not to suggest that one concept of time is better than another, but no other means of crossing this particular cultural divide was found. Perhaps having a local project manager, who held similar concepts of time to the local labour force, would be the most effective way of managing this issue.

Quality Control

The implication of differing concepts of space between the author and engineer during the projects was manifest in issues of quality control and ensuring the final project was constructed safely. It was necessary to closely oversee critical aspects of construction, for example by checking the depth of the trench dug at Emem where it passed below the road. It was also necessary to ensure designs were robust and able to accommodate a higher degree of variation in material and construction quality that might be necessary in the UK.

7.6 WIDER IMPLICATIONS OF RESEARCH

Using cultural theory to explain cultural misunderstandings has the advantage that it suggests boundaries within which findings may be applicable. For example, at Emem it is thought that commitment from the chief was an important factor for project success due to the organisation of the community as an 'extended family'. Therefore where other communities operate as an 'extended family' commitment of their chief (or alternative 'grandfather' figure) is likely to be equally crucial.

The issues experienced at both Emem and Baw relating to conceptions of time and space may also be experienced at other communities where time is conceived as 'polychromatic' and people show 'low territoriality' concern for space.

The issues outlined in example 4 is was a highly localised problem but the lesson of the need to consider the specific socio-cultural context of the communities in which projects are conducted is thought to be widely applicable.

7.7 ALTERNATIVE ANALYSIS

It is possible that there are other ways to analyse the events that occurred at Emem and Baw; it is not suggested that this interpretation is the only viable one. However, it is at least useful to see that there are different explanations of actions when viewed through an alternative lens. For example, using Hofstede's dimensions suggested that there may be an alternative explanation for the difficulties encountered with getting the community motivated to work once the chief left the village, other than the engineer's initial perception that the community had lost interest in the project. This is useful for increasing understanding and tolerance between cultures, and would have significantly reduced the engineer's frustration had she been familiar with the work of Hofstede prior to the project.

7.8 CONCLUSIONS

The general conclusion of this chapter is that project management needs to be planned and adapted very carefully for the local socio-cultural context in which the project is being conducted.

During the projects at Emem and Baw, local context was found to have implications for the management structure that might be appropriate for the projects, as well as for construction sequencing and quality control.

At communities with a high PDI score and low UAI score it may not be possible to negotiate directly with ordinary members of the community to organise labour, it may be more appropriate to negotiate through a senior member of the community who will act as the 'grandfather' and organise the community to work.

Construction sequencing may prove challenging when a manager is working with a workforce who work to a different concept of time. No particular solutions to this problem were found during the case study projects, however. Careful supervision of construction activities with critical dimensions involved may be necessary when working with a workforce who have low territoriality.

8 Health and Safety

This chapter is concerned with the implications of socio-cultural context for health and safety management during rural water and sanitation projects.

Community participation in construction during rural infrastructure projects in developing countries is encouraged by many Non-governmental Organisations. The health and safety aspects of this type of development model have not previously been adequately researched, however. This chapter aims to identify the socio-cultural factors that motivate community members to participate in construction activities which they perceive as hazardous as a first step towards understanding how health and safety can be more effectively managed during community development projects.

A qualitative approach has been taken, using interview, observation and reflection, to investigate the motivations of community members for engaging in hazardous construction activities during the case study project at Emem. It was found that the communal culture of the local context resulted in community members feeling pressurised to participate in hazardous construction activities. Local customary laws further compelled individuals as they were concerned they could be fined or arrested should they not fulfil their communal obligations.

Further work is required to determine the boundaries within which findings apply but it is likely that there are implications for others managing community construction projects both in Ghana and further afield.

8.1 RESEARCH AIMS

The research aims to:

- Explore the implications of socio-cultural context for the motivation of community members to engage in hazardous construction activities during the projects at Emem; and
- Consider the broader implications of this research for engineers engaged in water and sanitation projects in other regions.

8.2 CHAPTER STRUCTURE

This chapter considers the health and safety aspects of community participation in construction using the water project being undertaken at Emem as a case study.

The chapter begins by considering the relevance of different aspects of the health and safety context within which the case study project is located. In the first instance the role of laws and legislation in protecting community members engaged in construction projects is discussed. Discussion then turns to health and safety implications of socio-cultural environment on community construction projects.

Following this, methodological issues of specific relevance to this chapter are discussed and the key hazards encountered during the case study project, as identified by the author, are listed.

The results of semi-structured interviews conducted with the members of the community at Emem who participated in the construction work are offered before discussion turns to the implications of findings for engineers. The wider implications of the findings are considered before the conclusions are drawn.

8.3 LITERATURE

Many of the large Non-Governmental Organisations involved in rural infrastructure projects in developing countries encourage the participation of communities during the construction phase of project implementation. On WaterAid projects, for example, “Local people help with the building of wells and latrines by undertaking tasks like digging, collecting or providing materials, and putting fences around water points to keep animals away” (WaterAid, n.d. (b)).

Both Oxfam and Practical Action have run schemes where members of local communities are involved in construction projects as labourers and given some basic training in the hope that the new skills they develop may lead to employment opportunities. In Kitgum Town, Uganda, displaced women gained construction skills while working as casual labourers on a project aiming to create safe shelter for residents of surrounding villages who must sleep in the town at night (Clifton, 2005). Training during one Practical Action project, using unemployed young people to help construct housing for elderly members of their community, included setting out, trench excavation, footing casting, brickwork, hard core filling and roofing (Dongozi, n.d.).

The advantages of involving the community in their own development have been widely documented (for example see Robles-Morua et al, 2009). Community involvement increases the chances of a successful project by ensuring project work truly meets the needs of the proposed beneficiaries whilst encouraging ownership of the project by the community (Narayan, 1993). Overall, community involvement encourages long-term maintenance of the implemented systems improving the sustainability of the project (ibid).

However, there is not a clear conclusion from previous work as to whether enough has been done to ensure that community members are participating in their own development in a manner that is healthy and safe.

8.3.1 The Problem

Construction health and safety is an aspect of community development projects that has not been well researched. Currently the literature deals with construction projects in developing countries using a paid labour force. Development projects engaging the local community in construction are carried out in a different context from that explored in the literature, as those involved are not paid for their work and most have no prior construction experience. Without an understanding of the specific context of this type of project, it is not possible to ensure health and safety is managed in the most effective way.

8.3.2 The Context of Community Construction Projects

Laws and Legislation

Many developing countries have health and safety legislation in place to protect workers but experience difficulties in implementing the legislation due to a lack of mechanisms for enforcing it (Cotton et al, 2005; Kheni et al, 2008). Ghana is no exception; as Kheni (2006) notes there are several issues with Ghana's health and safety legislation including a lack of financial and administrative resource, a lack of construction accident statistics and problems enforcing legislation due to a failure of small and medium sized contractors to register construction sites.

Currently, national level legislation is likely to have limited impact on development projects utilising the local community as a free labour source. Whereas developed countries often include protection for unpaid workers (for example the UK Health and Safety at Work etc. Act, 1974 applies to any company that has more than one

employee and explicitly identifies a responsibility of all employers and the self-employed to protect people other than those at work), Ghana's Labour Act limits its scope of application to workers and employers (Labour Act, 2003: Part 1).

Whilst national laws may not protect individuals working on community construction projects in developing countries, traditional governance and local customary law may be of great relevance. Of particular significance to community construction projects is the existence of Communal Labour Laws, which require community members to participate in work for communal benefit, which are enforced at the local level by traditional chiefs and elders (Ubink, 2008). Kheni et al (2010) note the importance of local law for maintaining traditional values and ensuring they are enforced in society.

Socio-Cultural Environment

Nuwayhid (2004) highlights the importance of the political and socio-cultural environment to progress in health and safety by linking developments and set-backs experienced when developed countries moved to a more health and safety conscious culture, to social movements, healthcare and the general public's perception of health. He points out that, "Setbacks and regressions caused by changes in the political mood and the popular attitude toward work-related risks are not infrequent". This illustrates the importance of understanding a broad range of concerns, including social and cultural factors, when trying to find ways to improve the health and safety culture in a particular context.

Many authors have found Hofstede's framework to be a constructive means by which to structure exploration of the links between national culture and health and safety culture (for example see Mearns & Yule, 2009; Burke et al., 2008). The relevance of a region's cultural profile on health and safety management is examined in depth by Seymen and Bolat (2010).

One of Hofstede's dimensions, 'Individualism versus Collectivism', is of particular relevance during this chapter. Highly collectivist societies encourage individuals to put the needs of the group above their own personal priorities (Triandis, 1993). Some of the values associated with a high collective score include obligation to others, avoidance of conflict and maintenance of social harmony (Forbes et al., 2011).

As was noted in chapter 3, Ghana's culture is much more collectively orientated than the UK. West Africa (Ghana, Nigeria and Sierra Leone) scores 20% on the scale of individualism, compared to the United Kingdom's score of 89% (Hofstede et al., 2010). Seymen and Bolat (op. cit.) assert that this has implications for risk perception and employee involvement in health and safety management. Health and safety in collectivist contexts is more effective when seen as a communal responsibility rather than the focus being on each individual ensuring their own safety.

Kheni et al. (2007) provide an example from Ghana, where it was found that extended family social structures and collectivist values provide opportunities for health and safety management within construction companies. In the Ghanaian extended family, the head of the family has responsibilities to provide for and set a good example to the rest of the family. In the same way, the head of an organisation should have responsibilities for the health and safety of his workers. The local context provided an opportunity for health and safety procedures to be understood and incorporated into daily work.

The relevance of collectivism and individualism for health and safety management has also been demonstrated by Baarts (2009) who found that preferences and attributes of individuals impacts upon the way they approach safety and the risks they deem acceptable to expose others too. She suggests that, "it is a common belief that the more collectivist preferences, the less challenge and opposition, and the

more individualist the less social responsibility” (ibid). She also notes that in their extreme form, both collectivism and individualism can have negative consequences for overall safety of a group. Strong collectivism can lead to an unwillingness to challenge a dangerous group behaviour; strong individualism can lead to a failure to consider the safety of others during construction work.

8.4 METHODOLOGY

Full details of the methodology that frames the research can be found in Chapter 2.

Methods used for research for this chapter:

- unstructured informal interview to allow issues to materialise that had not been preconceived by the researcher;
- semi-structured interview to allow open ended answers to preconceived questions;
- observation to triangulate data collected by witnessing the health and safety procedures followed compared to answers given during interviews; and
- reflection by researcher and community on the observations resulting from changes made to health and safety practices during the action research cycle.

Appendix B shows the question guide used during the semi-structured interview.

8.4.1 Methodological Issues Specific to this Chapter

The goal of the research was to gain insights into the factors that motivate community members to engage in hazardous construction activities. In order to do this it was necessary to understand how the community perceived the hazards with which they were confronted. The hazards as perceived by the authors are discussed in the case study section below. However, it was not possible to simply ask the participants why they engaged in the activities identified by the authors as

hazardous, as it was possible that the participants would not perceive the activities as hazardous. Engaging in a hazardous activity due to unawareness of the danger present is a possible result, but the focus of this research was intended to be identifying the motivations for engaging in hazardous activity *despite awareness* of the danger present.

In order to deal with this issue a number of questions were included in the semi-structured interview that were intended to reveal insights into the participants perception of what constituted a hazardous activity. A difficulty arose due to the technical nature of some of the health and safety terminology that were not known to the participants or the translator prior to the research.

To address this a number of measures were taken during the interviews. Firstly, some of the key terms were defined at the start of the interviews. The concepts of hazard and risk were defined and discussed along with a range of associated feelings such as being afraid, thinking something is dangerous and thinking someone might get hurt. In addition, as activities were discussed during the interview attention was paid to clarifying how the participant felt about the activity. They were asked to say whether they felt the particular activity could have resulted in injury or harm to themselves or others.

It was assumed that if the participant thought someone might get hurt, or if they felt afraid or worried, that they had identified a hazard. In this case, questioning turned to the reasons the participant had continued to undertake the activity despite their concerns.

The time the author spent living and working in the community at Emem allowed for extensive observation of, and informal conversation with, the community members. Whilst much of the discussion in this paper is based on findings from semi-structured interviews carried out with the community, the knowledge gained

through observation and informal conversation informed the design of the semi-structure interview schedule.

It should be noted that the guide was not adhered to strictly during the interviews. This allowed interesting topics that arose during the interviews to be followed up in more detail and meant questions could be omitted when it was felt that they had already been answered or were not relevant to the particular individual responding. Some of the questions present options for the participants to consider. For example, in the motivations section several options are listed in response to the question, 'Why do you undertake labour for you community?' The options presented are motivations identified prior to the semi-structured interviews. During the semi-structured interview the participants were encouraged to add any other motivations they felt were relevant.

8.4.2 Case Study Project at Emem

Full details of the case study communities can be found in Chapter 4. Further information is provided here as directly relevant to health and safety issues.

The chief of Emem has implemented local laws at the village that require those of working age to carry out communal labour twice a week on Tuesdays and Saturdays. If for some reason a member of the community is unable to fulfil their labour obligations they can go and ask the chief and elders for permission to be excused. If members of the community refuse to carry out their communal labour obligations they are fined five cedi (roughly £2 at the time and equivalent to what some in the village earned after a day's fishing) for their offence. Persistent offenders are reported to the local police force who, according to local belief, will come to the village to arrest the guilty party.

Construction work at Emem was largely carried out by the community themselves with the help of paid, skilled labour where necessary. Skilled labourers working on the project included a plumber, a mason and a carpenter.

Twelve individuals were selected to participate in the research for this chapter. Due to the very small scale of the project, this constituted over ninety percent of the community members who regularly undertook communal labour on the project. Descriptions of the participants are given below. All names are pseudo names to respect the privacy of the participants.

Awuku was the project translator who also owned the boat that the project team used to gain access to the village during the rainy season when the village could not be accessed by road. He came from a village about twenty minutes journey by boat. He is also of Ewe ethnicity and can be considered an insider who knew many of the people living in Emem prior to the project commencing.

The Chief, Kwami and Mawuli are village elders. There are seven village elders in total but the other four were not involved in construction work due to their advancing age. Kwadzo, Kwao, Kofi, Kwasi and Fafa are younger men of working age who were regularly involved in construction during the project.

Kwabla was the youngest participant being only a teenager at the time the project was underway in the village. He took part in the project as he did not attend school and was therefore in the village during the day when the construction work was carried out.

The carpenter and the mason come from the same village as Awuku and were paid to carry out work that required skilled labour. They both worked at the village for significant periods during the construction work.

Hazards encountered during the construction phase at Emem included:

- Trench digging – with a risk of excavation wall collapse, especially when working near to the lake
- Personal injury through use of sharp tools
- Dehydration
- Sun stroke
- Working at height
- Back and neck injury due to manual handling of heavy objects
- Skin irritation from cement
- Eye irritation from cement
- Foot injury from nails and other equipment left lying on the floor

At Baw, skilled labourers working on the project included a mason, who worked throughout the project, and a carpenter and steel bender who worked as needed. Two men from the village of Baw worked as unskilled labourers helping the skilled labourers. They were paid a small amount as compensation for their time spent on the project.

8.4.3 Data Analysis

Data consists of interview notes (including recording of direct quotes) and field notes including observations and reflections. All the data has been analysed using a process whereby a coding scheme has been developed through consideration of the research questions, preliminary analysis of the data and data write-up. Two descriptive codes were used to identify any words, phrases or sentences from the interview notes relating to both 'hazard identification' and 'motivations'. The 'hazard identification' data was further subdivided according to whether the hazard was 'unidentified', 'identified but ignored', or 'identified and mitigated or eliminated'.

The 'hazard identification' code is problematic due to the methodological issues discussed above. Therefore the code was only used where the authors' perceived a clear hazard that had been explicitly unidentified, ignored or mitigated against. A note was made of the hazard as perceived by the authors.

Where data was assigned the code 'motivation', a note was made regarding whether comments related to specific activities or whether comments were more general in nature. Where 'motivation' data linked to specific activities, data was subdivided depending on whether the participant considered the activity hazardous or not and cross-referenced against any corresponding 'hazard identification' code.

8.5 RESULTS

A schedule of the semi-structured interview questions can be found in Appendix B. Where quotes from participants are included in the sections below, the translated quotes were recorded verbatim during the interview.

8.5.1 Hazard Identification

Questions 1, 2 and 3 were intended to identify the activities which participants felt were hazardous. A number of the responses given by participants were revealing in that they provided examples of the community failing to identify risks altogether. Examples were found during three of the semi-structured interviews. Kwadzo had been involved in constructing the roof for the guest house. During this activity he had to stand on the roof timbers approximately three metres above the ground to arrange the thatch that would form the rain barrier. With no harness system in place, this involved the hazard of falling from height. During his interview, however, he said that he did not think that being on the roof was dangerous.

During the trench digging activity to lay the transmission pipe which would carry water from the lake to the village an incident occurred where the trench was dug too close to the lake causing the trench to flood. Members of the community were working in the trench, which was around a metre deep at the flooded location. This led to a hazardous situation that could have seen the walls of the trench collapse, this was arguably the most serious incident that occurred during the project. Despite this, two men involved in the incident explicitly failed to identify the hazard. Kwasi said that digging by the lake is not dangerous and the Chief said that when the water was coming into the trench he didn't think, "anything bad about it".

In addition to the examples of failure to identify hazards, a number of the participants made comments that revealed a tendency to either ignore or accept hazards that had been identified. Mawuli made the general statement that he had never said he wouldn't do something because he felt it was dangerous. Kofi, who was involved in building the roof to the guest house with Kwadzo said that on one occasion he hadn't been feeling well but had still worked on the roof. He understood that it was dangerous to work whilst unwell but had proceeded to

anyway, ignoring the hazard. He also said that if you decide to do something you have to accept the risk.

Awuku made the general observation that, “Sometimes you die but sometimes you don’t”. After further questioning this was interpreted as meaning he was prepared to risk death for the sake of the project. Kwami made a similar comment when he said that he didn’t expect to get an injury during the project but if he did he didn’t mind. (Though this second comment should be treated with caution as it is possible that this could be interpreted as meaning that if he got an injury he would not blame the interviewer).

Throughout the interviews only one person made a comment that implied an attempt to mitigate or eliminate potentially hazardous construction activities. Kwami said that if an activity was dangerous he would try to find a means to make it safe. He also said that, “If I will die, I will not do the work”.

8.5.2 Motivations

All twelve participants answered questions about their motivations for working on the project. Where participants had identified their involvement in a dangerous task they were asked about their motivation for undertaking that particular task. Where participants had not identified any tasks they found particularly dangerous they had been asked more generally about their motivation for working on the project. The two paid labourers, the chief, a young boy Kwable and the research translator Awuku, have slightly different circumstances from the others and their motivations are discussed separately in the section entitled ‘Special Cases’ below.

Three factors arose during informal conversations with the participants preceding the semi-structured interview that seemed pertinent to the motivation of community members to take part in construction work. These were ‘feeling obliged

to in order to comply with local communal labour laws', 'concern over other members of the community thinking badly of them if they did not take part' and 'wanting to improve their communities'. During the interview the participants were asked whether there were any further reasons they undertook communal labour and were then asked to rank the factors in order of relevance to themselves.

Of the seven 'typical' participants, all said that the three factors already identified were relevant and five said they did not have other motivations for undertaking community work to add to the three listed (Kofi, Kwao, Kwami, Kwasi and Mawuli). The other two participants added one further motivation each: a fear of arrest (Fafa); and the fact that their fathers have always done it (Kwadzo). Kwadzo, in an informal conversation following the interview, also highlighted the fact that he often undertook work as a favour to somebody. In the case of the project work it was if Awuku, his friend, asked him to work. It was observed that Awuku, who was widely liked amongst the community, was able to encourage some members of the community to work out-with communal labour hours when they had previously said they would be unavailable.

All seven participants rated, 'I want to improve my community' as the most relevant to why they undertake labour for the community. Four then cited, 'I have to it's the law' as the second most relevant factor (Kwami, Kwao, Mawuli and Fafa) and three cited 'People will think badly of me if I don't' (Kwadzo, Kwasi and Kofi).

Following this ranking exercise the participants were asked to answer some open ended questions about their motivations for undertaking communal labour they perceived to be dangerous to see if any additional factors arose. The relevant questions are questions 5 to 7 in the interview schedule.

Motivation – Others Thinking Badly

Six of the seven typical participants were concerned that other people in the village might talk about them if they did not participate in communal labour. Kofi said that he thought people would talk about him if he couldn't do communal labour; he also said that he was a hard worker and didn't want anyone to say otherwise about him. Kwao also said that he thought people would speak badly of him and insult him if he didn't attend communal labour.

Kwasi and Fafa said that people would talk about them if they did not undertake a communal labour task even if the work was dangerous. Kwadzo noted that he wouldn't be able to stop a task if people started to complain about him and he would continue to try for a bit longer. Kwami pointed out that the community did not have a formal system for recording who was helping with communal labour but they noticed those who were not.

The seventh participant, Mawuli said that he was not worried about people speaking badly about him because he has never said he won't do a task because it is dangerous. He did agree that 'people thinking badly' was a motivation for undertaking communal labour in the ranking exercise above however.

Motivation - Issues with the Law

Kofi, Kwao, Kwasi and Kwami all said that they would have problems with the local law if they failed to undertake communal labour. Kofi said that he would get into trouble if he could not work and that even if work was dangerous the chief and elders could still arrest him. Kwao said that if you do not do something because you think it is dangerous the elders will arrest you or fine you. Kwasi also said that he would be fined if he did not work even if the work was dangerous. Kwami said that the fine for not working was five cedi.

Conversely, Kwadzo said that it was possible to stop without breaking the law. Kofi said that if you were ill it was possible to ask the chief to be excused from communal labour that day.

Motivation – Improvements to the Village

Mawuli, Kwao, Kwadzo, Kwasi and Kofi all said that they would be more prepared to undertake dangerous tasks if they could see the clear benefit and importance of the task for the community.

Special Cases

The project carpenter and mason were expected to have different motivations for taking part in the project work as they were not members of the community and would not benefit from the project other than from the wages they earned for their labour. Both the carpenter and mason identified their wages as the key motivator for undertaking work for the project and the mason said that if work was dangerous he would simply increase the price to make accepting the danger worth while.

Kwabla was distinct from the other participants in that he was still of school-going age and therefore communal labour was not compulsory for him. When answering the ratings question he therefore disagreed with two of the factors, 'I have to it's the law', and 'people will think badly of me if I don't' but agreed with the factor 'I want to improve my community'. He added to this an additional motivation that people would think 'good' of him if he helped on the project. He also noted that he is the only boy of his age not at school and therefore he would rather come and work on the project and be with the men rather than on his own. He also said that he was interested in what was happening with the project and often came to help out of curiosity.

Awuku was the translator for the research, for which he was paid, but when not required for translation he often joined the men from the community in labour out

of choice. In his words, "Our arrangement was to be translator and boat man but I didn't think of it like that. I just want the project to improve."

In his interview he talked of the responsibility he felt to encourage others to work on the project, "[The project] has come to help the Ghanaians and I have to show them the benefit the work can bring. Sometimes people do not understand the benefit. I brought you here and if others see me working even though I'm not from here they will think they have to come and help." Guilt was another factor in his motivation, "I am hard worker and if I see someone is doing some work and I am not involved I don't feel right. I feel guilty because of how I'm brought up."

Lastly, it is clear from Awuku's interview that social status is also an important feature of communal labour. This is apparent when he discusses what would happen if he were to die working on the project, "People will remember me if I die working hard on a project like this. Maybe people will publish in many places". By 'publish', he was referring to the widespread publicity that those who have been well-respected members of the community receive for their funerals.

Like Awuku, the Chief noted the importance of his position when he said that he has to set an example for the rest to see so that they will work on the project. He also demonstrates the responsibility he feels when he says, "The elders chose me to be Chief and therefore I have to work hard and do the dangerous work before the others". It was observed during the project that the chief was often most involved during the more hazardous activities, taking up the more dangerous role and sending members of the community to do other jobs.

Summary of Factors:

The following list compiles all the factors that came out of the interviews explaining motivations behind the participants' involvement in community construction work:

-
- Feeling compelled to work for fear of arrest or being fined for infringement of local laws
 - Concern about being spoken about badly by other members of the community
 - Wanting to improve facilities within the community
 - Following in the footsteps of fathers and ancestors who have always contributed to communal labour
 - Interest in what is happening in the village
 - To gain respect from others in the village
 - To feel socially included in village life
 - As a favour to a friend
 - To avoid a feeling of guilt if others are working hard
 - To set an example to others and encourage them to work

8.9 DISCUSSION

The results provide evidence that some hazardous activities were undertaken simply through community members' lack of appreciation of the danger present. This supports the findings of Haupt and Smallwood (1999) and is evident from the interview quotes such as, "I don't think being on the roof is dangerous", and, "When the water was coming when they were working I didn't think anything bad about it". In both instances the participant is discussing activities which had clear hazards - in the first case fall from height and in the second excavation wall collapse. In both instance the participant clearly state they do not perceive there to be danger involved in the activity.

Due to the methodological issues associated with terminology and translation discussed above, it is difficult to assess the extent to which hazards were not identified. However the above quotes make it clear that apparent lack of awareness did account for at least some of the willingness to engage in hazardous activities.

Evidence was also presented for times during the construction work that the communities had identified risks that they had chosen to either ignore or accept. For example, one man described the way that he wasn't feeling well but still chose to work on the roof. He described the way that if you decide to undertake work you have to, "accept the risk". Further participants made more general comments alluding to the need to accept risk. This indicates that there are motivations and/or pressures at work that encourage members of the community to undertake activities which they know to carry an element of risk.

The only participant to make reference to their own ability to mitigate or eliminate risks by finding another way to carry out hazardous activities was Kwami. It should be noted, however, that Kwami is an elder of the village and it is possible therefore that he is better positioned to take control of his own and others safety during communal labour than are the 'typical' participants.

The two paid skilled labourers identified receiving payment as the key motivator for their involvement in construction work and the mason said that he would be prepared to carry out work that he considered dangerous but would increase the price according to the additional risk he perceived present in the task. This finding is in line with the findings of Kheni et al. (2010) who noted the economic situation in many developing countries mean that, "Many site workers are content to earn better wages under poor OH&S [occupational health and safety] working conditions". They identify cheap sources of labour and the low socioeconomic status of workers as key barriers to improving health and safety in developing countries (ibid).

One of the motivations expressed by participants was a desire to improve their community. This was a motivation that everyone interviewed agreed with when it was suggested by the interviewer during the ranking exercise, but which was less often brought up in open-ended questions. Whilst most people in the village did

seem to have a genuine desire to improve their community, this did not seem to be a key motivating factor. It is possible that the participants felt that agreeing with the factor would constitute the 'correct' answer, the answer they felt the interviewer wanted.

Many of the other motivations for working appear to originate in the social and cultural context of the village and reflect a collectivist attitude; in particular the fact that participants felt compelled to continue with work they felt was dangerous if others in the community began to think or talk badly of them or because they would gain respect from the community for their efforts.

Risk is viewed as an integral aspect of development; accepted by the community members' fathers and ancestors and demonstrated by the participant who rejected the need to make methods safer because, 'Our fathers have always done it'. Refusing to accept the risk is akin to failing to carry out social responsibilities and can therefore leave the refuser susceptible to social disgrace. For many the social risk is of greater importance than the risk to personal harm of carrying out a particular task.

This mirrors Baarts (2009) analysis of the dilemma faced by the health and safety representative during her ethnographic fieldwork. The representative was faced with the task of removing a lamp on a jib arm which had broken loose; a job that fell to him under his responsibilities as health and safety representative. His physique, however, was such that he would not be able to wear the harness that would usually have been worn to go up in the carrier and fix the lamp. He went up without the harness, demonstrating that his desire to fulfil his responsibility was greater than his concern for his safety. Noteworthy in this instance was the fact that his behaviour did not have implications for other members of the group, it was only he himself who was put at risk.

Children from Emem are brought up from a young age to conform to communal values, as reflected in one participants expression of the guilt he feels when he sees someone is working, which compels him to go and help even where work is hazardous. Adults in positions of responsibility set a “good” example to the children and other members of the community by undertaking dangerous work themselves, thereby demonstrating their commitment to the village and their personal sacrifice for the greater benefit of everyone. Social etiquette also requires individuals to work when requested by a friend or family member.

None of the participants identified, ‘learning new skills’ as a motivation for taking part in construction activities. This is an interesting result as the literature identified ‘learning new skills’ as a key outcome of community involvement in construction (Clifton, 2005; Dongozi, n.d.). It is possible that the initial approach of the project team plays a big part in setting the expectations of the community for the benefits the project will bring. In the case of this research, communities were approached with the idea that they could gain a water or sanitation system for their community if they were prepared to put effort into the construction. In the case of the Oxfam and Practical Action projects individuals may have been approached with the promise of increased employment opportunity through the skills learnt through their construction work efforts.

Local laws reflect and enforce the communal values held by many in the community and provide the means by which individuals can be fined or arrested if they do not adhere to social duties and carry out communal labour. This seems a particularly problematic aspect of construction management when construction is carried out by unpaid community members on behalf of their own village. Employees engaged in paid construction work do have some rights under the legal framework, despite the difficulties that exist as discussed above. In the case of the unpaid community construction worker, they are not explicitly covered by national Legislation that

could protect them but are exposed to local laws which in the most extreme cases could oblige individuals to partake in dangerous construction activities.

8.10 LIMITATIONS, RECOMMENDATIONS AND FURTHER WORK

A limitation of the research is the small sample of data collected from case study projects in a very particular context. The extent to which findings can be generalised to other contexts is not obvious.

One of the key findings of the research was the implications of local laws for health and safety management during community construction projects. The finding presents a serious barrier for safe construction process. A limitation is found in the highly variable nature of local laws; it cannot be assumed that the same laws will be encountered in construction projects in the next village, never mind other countries in Sub-Saharan Africa. Nevertheless, the finding is significant as it raises the issue of local laws as something that need to be explored and considered when engaged in community construction projects in sub-Saharan Africa.

Other motivations found were suggested to be associated with the collectivist culture of the community at Emem. It is not possible to determine from this work alone whether these cultural characteristics should be attributed to the community as Ewe, Ghanaian or African. Hofstede works at the national level but notes that variations occur within countries and similarities occur across regions (Hofstede et al., 2010).

That said, the research highlights a range of issues which development practitioners and engineers should be aware of. It is recommended that professionals engaged in this type of construction work keep in mind the findings of this research and consider the relevance for the particular context of their own projects. It is thought

that other construction projects of this nature would benefit from the project managers taking the time to identify the motivations and pressures that encourage engagement in unsafe behaviour. This is a necessary first step to planning ways to reduce these pressures.

It is recommended that projects, such as the one at Emem, in which community members are concerned that they may be arrested if they do not undertake hazardous construction work be managed particularly carefully.

Further work is required to address the issue of ability to generalise highlighted above. Undertaking similar research in more locations would help to build a more complete understanding of the range of factors that motivate individuals to engage in hazardous activities during community construction projects, as well as how the factors vary geographically and culturally. In addition, ways of adapting health and safety management frameworks to reduce the pressures placed on community members during this type of project need to be explored.

8.11 CONCLUSIONS

The context within which community construction projects are undertaken presents specific challenges for health and safety management. The aim of this research was to identify the motivations that cause community members participating in construction to engage in hazardous activity despite awareness of the danger present. It was found that the communal culture of the local context resulted in community members feeling pressurised to undertake construction activities even when activities were perceived as dangerous. Local traditional laws were found to be the mechanism through which community members were obliged to take part in hazardous activities. Whilst the research is inconclusive about the boundaries within which these findings apply it is likely that there are implications for others managing community construction projects both in Ghana and further afield.

9 Engineering Education

It is apparent in the preceding chapters that the nature of engineering when engaged in rural water and sanitation projects in developing countries is different from that of typical projects in developed countries (see for example chapter 6 which discusses the difference between engineering in the UK and in developing countries). This chapter considers the skills engineers need when engaged in rural water and sanitation projects in developing countries and whether a different type of engineering education is required to deliver engineers with the relevant skills to tackle the challenges of this type of engineering.

During the case study projects many challenges were encountered that arose due to the nature of rural water and sanitation projects in developing countries. Many of these problems could be expected to be encountered by other engineers working to reduce rural poverty, which often involves working cross-culturally, directly with communities and/or working in difficult environments in developing countries. This chapter compares the skills that were required of the author during the case study projects in Ghana and compares them to the skills required by the Joint Board of Moderators (JBM) on completion of a Masters Degree in Civil Engineering.

It is found the majority of skills needed by the author are in fact skills the JBM requires of engineers currently; there is no fundamental difference between the skills required of engineers working in a rural water and sanitation context from those of engineers working in other contexts. It is suggested that the inclusion of case studies of an international development nature could be an exciting and engaging way of exposing student engineers to challenges that allow them to develop many of the skills they will need in their future careers, whether they go on to tackle rural poverty or not.

9.1 RESEARCH AIMS

This research aims to:

- Identify the skills needed by the engineer during the case study water and sanitation projects at Emem and Baw in order to overcome the challenges encountered during the projects;
- Consider the extent to which mainstream engineering curricula, as specified by the Joint Board of Moderators, prepares students with the skill set identified; and
- Consider the need for a separate education for producing engineers with the skill set needed to work effectively to fight poverty.

9.2 CHAPTER STRUCTURE

The chapter first identifies the challenges encountered during the projects at Emem and Baw and contemplates the skills engineers require to face these challenges. Following this, consideration is given to the extent to which these skills are currently included in mainstream engineering curricular. Finally, discussion turns to how these skills can be introduced into an already full-to-the-brim engineering curriculum to produce engineers with the skill set needed to work effectively in the fight against rural poverty.

9.3 BACKGROUND

As noted in Chapter 2 engineers have a vital role to play in the global fight against poverty. Due to the lack of foreign engineers in many developing countries often engineers from developed countries will need to cross borders in order to assist developing countries in the provision of infrastructure such as water and sanitation systems.

The nature of engineering when working in rural areas of developing countries is quite different from that of typical engineering work undertaken in developed countries, however. Many of these differences were noted in Chapter 6, including the need to use different types of technologies from those commonly employed in developed countries, the requirement for increased focus on community participation and the necessity for the engineer to explain the scientific and engineering principles behind the technology to the community. As the nature of engineering is different so, it is hypothesised, are the skills required.

Mainstream engineering curricula in developed countries are not necessarily intended to provide the skills required for work in rural poverty alleviation in developing countries. That said, however, rural poverty is a global problem and, whilst rural population levels are likely to peak between 2020 and 2025, rural poverty will demand the attention of engineers for the foreseeable future (IFAD, 2011). It is necessary to produce the engineers with the skills required to tackle these challenges.

9.4 CHALLENGES ENCOUNTERED AND SKILLS REQUIRED

9.4.1 Practical Problems

The first challenges encountered during the fieldwork were of a very practical nature. The projects were to be carried out under the auspices of Original Volunteers, a Non-Governmental Organisation with local knowledge and a broad range of contacts. Through Original Volunteers the case study locations were identified and a translator, a mason and a carpenter hired. In the local area there was much development and volunteer activity already being carried out in the areas that were easily accessible by road and the communities who really needed assistance were the ones that were harder to get to.

Emem is situated about half an hour's walk down a dirt track which is just barely passable by car for periods during the dry season and is only accessible by foot, if you are prepared to wade, or boat during the rainy season. Baw is situated around forty minutes' drive down a dirt track road which is accessible by car for the whole year but is a difficult journey at times due to poor maintenance of the road. Whilst Emem is on a road with police check points, which means the taxi drivers are not able to overload the vehicles with more than four passengers, it is common for taxi drivers to load six or seven on the road to Baw. The taxis that drive to Baw are what are known as village cars, that is they can only be driven around the villages and cannot be taken on the tarmac road due to being un-roadworthy. In a taxi to Emem you are lucky if there is a seat belt; in the taxi to Baw you are lucky if your car has doors!

Blocks and cement can be purchased from several locations around the Kwahu plateau and it is reasonably straightforward to organise for them to be delivered to Baw at all times and Emem if the road is passable. Gravel is another matter, however. Gravel had to be purchased from Nkawkaw, the nearest big town, which is unfortunately at the bottom of the Kwahu plateau and over an hour's drive from either Baw or Emem. In an attempt to gain work many of the truck drivers from Nkawkaw will overload their trucks despite the steep and treacherous road up to the Kwahu plateau with the result that many hours during the initial phases of the project were spent sitting on the side of the road waiting for truck engines to cool down.

Many of the rural areas needing infrastructure are in remote and challenging locations. This has several implications for the skills needed by engineers. Perhaps most important are the health and safety issues involved with undertaking work in this context. First aid becomes an important consideration when working in such remote areas. In addition, engineers need to be creative problem solvers in order to overcome the logistical problems they encounter.

9.4.2 Technical Challenges

Like every other engineering project the projects at Emem and Baw presented technical engineering challenges which needed to be overcome. Some of the technical challenges encountered are described in Chapter 5 of this thesis. Often engineering designs implemented in developing countries are considered to be low-tech and simple but the basic underlying scientific and engineering principles upon which they rely are the same. At Emem an understanding of fluid dynamics was necessary to design the water transmission system and structural mechanics to design the support for the 5,000 litre water tank. At Baw an understanding of soil mechanics was necessary during the excavation of the three meter deep pit for the latrines.

Despite technologies being “simple” engineers still need to be technically competent to work in developing countries. At times there is a great deal of creativity needed to find solutions to problems.

The skills required to overcome the technical challenges encountered included problem solving ability in design, knowledge of scientific and engineering principles and knowledge of existing technologies.

9.4.3 Working in a Different Culture

During the case study projects a number of issues arose due to the cross-cultural nature of the projects. Chapter 7 highlights the issues that arose, and the implications that this had for project management at Emem. It was found, for example, that social structures within the community meant that the engineer had to make arrangements with the chief of the community and that he would organise the community to work. It was not possible for the engineer to negotiate directly with

the community. Differing conceptions of time and space between the engineer and community were also important considerations.

Chapter 6 notes the importance of being able to communicate effectively with the local community in order to understand the social and cultural dimensions that have implications for the system design. Without the participation of the community systems are unlikely to be sustainable in the long term.

An understanding of the differences between cultures is a requirement for any engineer involved in cross-cultural engineering projects. Being able to communicate cross-culturally is important for both the design of the systems and for project management.

9.4.4 Corruption

Every country is susceptible to issues of corruption and Ghana is certainly not the worst in the world in this respect. That said, during the case study project corruption was encountered in ways that would be surprising in engineering work in the United Kingdom. The police often collected money from the Ghanaian taxi drivers for a range of offences from out of date car tax to wearing the wrong shoes to drive in. The police often try to conceal this bribery when there are foreigners in the taxi and on no occasion observed during the fieldwork was any foreigner asked to pay a bribe. The police are aware that this is unacceptable to many foreigners and do not want to run the risk of being reported.

In addition, on one occasion during the fieldwork corruption was encountered with potentially much more serious consequences. On this occasion, gravel was being sought for Baw and a truck had been hired to collect the gravel from Nkawkaw. The usual gravel supplier had just sold a lot of their stocks and there was not enough remaining for the project requirements. The truck driver said that he knew

another supplier and made a few quick phone calls and off we went to the location of the alternative supplier.

Like many of the material suppliers there was no particularly official looking yard, there was just a pile of stones beside the road. The author and truck driver were greeted by the man in charge who gave a price that seemed unusually high compared to the usual price of gravel. Before negotiations for the price had been completed he had ordered the truck driver to load the truck and was rushing though negotiations about price and getting quite agitated by my hesitance. Initially this hesitation was just about the price but then increased due to the amount of pressure to quickly make the purchase and leave.

It transpired that the gravel did not in fact belong to this man at all; it had been bought by a contractor working on a new road construction. This man worked for the contractor and all the men around the site had planned to sell the gravel and split the profit. The contractor could appear on site at any moment which was why they were keen to sell the gravel quickly and get our truck off site.

Corruption is a problem in many countries around the world. Understanding corruption, its different faces and how to identify and cope with it, is essential for any engineer working in developing countries. Without this understanding engineers could play a part in feeding corruption or in the worst case end up in jail, unable to use their skills to help anybody.

9.4.5 Limited Design Information

Throughout the project, one of the issues experienced was difficulty gaining access to the information required upon which to base the design of the system. Ideally a fuller understanding of the water levels in the lake would have been obtained prior to commencing construction and more geological data would have been available.

In some regards, understanding historical data on water levels in the lake is inadequate due to the political aspects of the dam management.

The authors' experience of dealing with Government Institutions was varied in Ghana. On the positive side all the Institutions visited were extremely welcoming and happy to give up their time to discuss the project. Gaining access to even the highest level of director was simply a case of knocking on their door and introducing yourself.

Often the problems arose where there was only one person who could provide the information sought and that person was out of the office. After three failed attempts to catch the director of the Geological Survey Department in Koforidua, seventy five kilometres from the project, time pressures meant construction had to begin. The backhoe arrived on site and everyone just hoped we would not hit bed rock whilst digging the deep trench between the intake and pump. At the time of writing, water quality results are still awaited from the Ghana Standards Board. Results were promised three weeks following submission of the water samples, now over a year ago. The problem was compounded by the distance to the nearest internet café (over an hour's drive from the project) and the reliability of the connection.

This challenge requires the engineer to be able to design through uncertainty and make decisions without always having all the information that would be desirable. In addition engineers need skills in creative problem solving to be able to find inventive solutions and adapt designs as unexpected issues are encountered. They need to produce creative designs that are flexible to future changes in circumstances.

9.4.6 Quality Control

Chapter 7 identifies some of the issues with quality control that occurred during the case study projects and it is noted that issues of quality control have a cultural dimension. The key worry with regards to quality control is that a foreign engineer designs a system which uses materials efficiently and close to their capacity and the system is then built by a local workforce who do not understand the accuracy that is required or do not understand the critical technical aspects of the design and that this leads to a dangerous and unsafe construction.

There were several ways that quality control was an issue during the case study projects. Firstly, it was difficult to purchase materials of a high quality. The concrete blocks were largely of unknown strength as they were hand made and there was no testing equipment to determine the strength. The concrete mix was not carefully measured to any particular ratio, the men worked from experience of the type of consistency that was required, with a strong motive to use as little cement as possible as this was the most expensive raw material.

As a result some blocks would break in two in your hands as you picked them up from the block yard to load the truck. It was necessary to specify the mix required for the blocks and check each block for quality as it was loaded onto the truck. The mason had to use his experience to reject blocks that he did not feel were of high enough quality. Ideally, it would have been beneficial to have someone who could stand and watch the blocks being made and guarantee that the correct concrete mixes were being used, but this was not usually possible.

The skilled labourers had built up experience of working with the local materials and construction methods which was often invaluable but on occasion important technical considerations were not understood. For example, it was noticed that many of the masons were not building adequate foundations on other projects and

when they did build foundations they were usually raft foundations with the masonry set at the edge of the foundation rather than setting it a couple of hundred millimetres from the edge.

During the project at Emem the mason was building the supporting structure for the raw water tank which needed to be of adequate construction quality to support 5,000 litres of water. He began to build the masonry on the edge of the foundation, which would have had a further impact of increasing the slab size by 400 millimetres from the design. He had only laid a couple of blocks however so it was easy for him to move them into the correct position.

When the same mason was building the toilet block at Baw he correctly located the wall position for the pit. The slab was then laid and he began to build the walls around the cubicles. He positioned the cubicle walls not above the pit walls below as had been intended but set them in about 150mm. When asked why he had done this, he said that you should never set blocks on the edge of the concrete. This illustrates both some of the difficulties that occurred in ensuring quality was maintained during the construction and the misunderstandings that can occur when communicating technical ideas.

Engineers working in developing countries need to be creative in their engineering design to ensure designs are robust and safe to build and use even with uncertainty in the quality of materials used. They need to have the construction management skills to be able to put in place the training and construction processes required to ensure systems are designed to a high enough standard. Like any construction project, engineers need to know what the critical aspects of the design are and take extra care to ensure those aspects are well constructed. Knowing the local culture and skilled labourers will help to predict where issues may arise.

9.4.7 Problems that had Social and Cultural Dimensions

There were many non-technical aspects to the projects carried out at both Emem and Baw. The only way to understand and identify these critical considerations was to spent time with the communities and build relationships and trust. It was vital to be accepted by the community so that they would share their opinions and way of life. This was not a quick process but it was important for ensuring the long term sustainability of the infrastructure constructed.

One of the problems encountered during the early stages of the project was that much of the information shared was difficult to comprehend as a Western engineer with an almost exclusively scientific comprehension of the world. Often it was difficult to know what to do with the information that was being received as it did not assimilate easily with an existing scientific worldview. The author has since come to realise that a pre-requisite to understanding the viewpoint of others is a critical examination of that of your own.

During the fieldwork the author came to the opinion that a critical realist perspective is more appropriate and useful than a scientific outlook for working in contexts such as the case study communities. For a scientist reality is independent of their experience of it. In other words, science does not have any means with which to deal with socially constructed phenomena. It is difficult therefore to understand communities who talk about the powers of voodoo and the harm that can come to you if you do not keep the spirits happy. To be philosophically consistent, as a scientist you would have to say that voodoo does not exist and no harm can be brought upon anybody through the powers of voodoo. It is very hard to design for something which does not, according to your way of thinking, exist. As a critical realist or constructivist you can say that voodoo does exist as a socially constructed phenomena and real harm can be caused through belief in voodoo

alone. In this way there are tangible aspects of local beliefs that may or may not need to be incorporated into designs.

In addition, scientific inquiry did not provide the tools needed to research social and cultural phenomena. Moving to a critical realist framework allowed the use of a combination of quantitative and qualitative methods necessary to effectively research the complete range of factors relevant to the design of the systems. It was necessary to learn how to carry out qualitative methods such as interviews, how to analyze the data collected as well as how to incorporate all the different aspects into the system design.

Finally, it was invaluable at times to turn to the social sciences for basic concepts and frameworks with which to understand and analyse observations and events that occurred during the projects. For example, in Chapter 7 there is discussion of how the social structure at Emem impacted on construction management during the project. It was found that it was not possible for the engineer to negotiate directly with members of the community to organise a work schedule as this contradicted the power structure within the village. Prior to reading the work of Hofstede, whose cultural dimensions form the basis of this understanding, it was difficult to make sense of the difficulty that was being experienced in organising work to continue since the chief had begun to stay away from the village. It seemed as though the community were unhappy with the project and had lost interest in its completion.

To work effectively in other societies and different cultures engineers need to increase their ability to communicate effectively with others and build cross-cultural relationships. An ability to incorporate social, cultural and political aspects into engineering design is essential for successful rural infrastructure projects if they are to be sustainable in the long term. An understanding of the philosophy of science

and alternative perspectives is valuable to understand other perspectives and incorporate alternative views into engineering designs.

9.4.8 Ethical Dilemmas

There were many ethical dimensions to the case study projects at Emem and Baw. The communities' rights to the health benefits of water and the dignity of sanitation had to be offset against the potential risk of undermining the communities' rights to self-determination. Great care was required to ensure that the communities were not left in a worse situation than before the project began, having asked the communities to invest their hope, time and money in the projects.

With all community work of this nature it is necessary to consider how projects impact on different stakeholders. For example, there is the chance that some may be left worse off than before the project even if the majority are better off. In addition there was a risk of altering the dynamic between the case study villages and other villages in their respective areas.

Even with the best intentions, there are many complex ethical dilemmas involved in rural community development and engineers need to be prepared with the skills to cope with these.

Dealing with ethical issues requires that engineers have the ability to both identify and manage ethical dilemmas. Being able to anticipate dilemmas in advance and cope with those that arise are key skills for engineers.

9.4.9 Summary of Skills Identified

Skills useful for effective engineering design:

- Problem solving – design
- Knowledge of scientific and engineering principles
- Knowledge of existing technology
- Designing and decision making in uncertainty
- Incorporation of health and safety and buildability into design
- Cross-cultural communication
- Incorporating social, cultural and political aspects into design

Skills useful for effective project management:

- Problem solving – logistical
- Health and Safety Management
- Quality control management
- Cross-cultural management and communication

Ethical and philosophical skills:

- An ability to recognise and manage ethical dilemmas
- Dealing with corruption
- Philosophy of science and alternative philosophies

9.5 *CURRENT ENGINEERING CURRICULA*

The Joint Board of Moderators (JBM) has been formed by four of the major engineering institutes in the United Kingdom, the Institution of Civil Engineers, the Institution of Structural Engineers, the Institute of Highway Engineers and the Chartered Institution of Highways and Transportation. Its role is to oversee the training of engineers including ensuring a consistent minimum standard is met of education delivered through university courses. Universities not reaching the

minimum standard do not receive accreditation and it is much more difficult for their students to become Chartered. The JBM produces guidelines which all universities must meet in order to become accredited and therefore these guidelines determine the basis of the engineering curriculum throughout the United Kingdom.

The Guidelines for a Master of Engineering (MEng) accredited degree item 1, programme objectives, state that, “an accredited MEng programme is intended to provide the distinctive educational base that will produce graduates who are practical, articulate, numerate, literate, imaginative, versatile, confident and inquisitive”, and, “They will need to develop an understanding of the construction industry, its role in wealth creation, the social and political context within which engineering is practised, the role of civil engineering in shaping the physical and social environment and its diverse contribution to the quality of life and social justice” (JBM, 2009a). In addition the guidelines note that, “It is anticipated that MEng programmes will vary in emphasis between one university and another, but they should be designed to provide the base for differing careers within the same discipline” (ibid).

Tables 9.1, 9.2, and 9.3 note references contained within the JBM guidelines for accredited Master programmes with regards to the skills identified as necessary for engineers engaged in rural poverty alleviation.

Skill	References in JBM Guidelines
Problem solving - design	None
Knowledge of scientific and engineering principles	“Provide a context in which the principles of engineering science, and other parallel taught courses, may be applied in the creative design process” (JBM, 2009b)

Table 9.1: References to design skills in JBM guidelines (continued on next page)

Skill	References in JBM Guidelines
Knowledge of existing technology	"A thorough knowledge of historical precedent" is required for the design process. (ibid)
Designing and decision making in uncertainty	"An ability to cope with the uncertainties associated with the multitude of factors making up the design brief". (ibid)
Incorporation of health and safety and buildability into design	<p>"Understand how the construction method, issues of safety and legislation, and the concepts of buildability can drive design. (ibid)</p> <p>"Understand how to identify and assess risks throughout the design process and decide on methods of elimination and/or control". (ibid)</p>
Cross-cultural communication	<p>Section :1 universities to provide the education base that will produce "articulate" engineers (JBM, 2009a). Section 3.8: "It is fundamental that engineers are able to communicate with confidence and clarity to their professional colleagues, the public and the other professions" (ibid).</p> <p>"An ability to interact with clients to help both client and other team members develop a better understanding and definition of the brief and the functional, social and economic objectives" (JBM, 2009b).</p>

Table 9.1: References to design skills in JBM guidelines (continued from previous page and onto next page)

Skill	References in JBM Guidelines
Incorporating social, cultural and political aspects into design	<p>Section 1 notes the importance of engineers who “understand the social and political context within which engineering is practised”, “the role of engineering in shaping the physical and social environment” and the “diverse contribution to the quality of life and social justice” (JBM, 2009a).</p> <p>“Understand how economy, sustainability, ethics, politics, and the impact on society can affect design” (JBM, 2009b)</p> <p>“The student should be able to... look beyond technical design solutions to impacts on local stakeholders” (JBM, 2009c).</p> <p>“The student should be able to... Produce solutions to problems which are profoundly interdisciplinary in nature” (ibid).</p>

Table 9.1: References to design skills in JBM guidelines (continued from previous page)

Skill	References in JBM Guidelines
Problem solving – logistical	None
Health and Safety Management	<p>Section 3.4: health and safety should be embedded in design courses (JBM, 2009a)</p> <p>Health and Safety Risk Management covers all aspects of health and safety management (JBM, 2009d)</p>

Table 9.2: References to project management skills in JBM Guidelines (continued on next page)

Skill	References in JBM Guidelines
Quality control management	3.11: "Programmes should introduce the concept of quality systems and the need for a quality approach to be intrinsic to all activities" (JBM, 2009a)
Cross-cultural management and communication	None

Table 9.2: References to project management skills in JBM Guidelines (continued from previous page)

Skill	References in JBM Guidelines
An ability to recognise and manage ethical dilemmas	Section 2.3 of Annex F: "where students are taught about ethics, they will: Understand the nature of professional responsibility; Be able to identify the ethical elements in decisions; Be able to address and resolve problems arising from questionable practice; Develop critical thinking skills and professional judgement; Understand practical difficulties of bring about change; Develop a professional ethical identity to carry forward in their working life" (JBM, 2009e).
Dealing with corruption	Is covered above under, "be able to address and resolve problems arising from questionable practice" (ibid)
Philosophy of science and alternative philosophies	None

Table 9.3: References to ethical and philosophical skills in JBM guidelines

The above tables show that many of the skills identified as important for engineers working to reduce rural poverty are already identified by the JBM as skills that should be covered during all engineering masters curricula.

Whilst the importance of communication is noted in several places in the guidelines there is no explicit reference to an ability to be able to communicate cross-culturally. Likewise, project management skills are included in the guidelines but without any reference to cross-cultural management. The ability to work cross-culturally has been highlighted above as an important skill for engineers working in rural poverty alleviation. In today's global world however, it seems likely that an ability to work in a multicultural environment will be essential for every engineer (Soibelman et al., 2011). Even engineers who never work abroad will encounter co-workers with different cultural outlooks.

Little emphasis is placed on the importance of understanding philosophy of science in the guidelines. The ability to incorporate social, cultural and political factors into engineering design is referred to often but there are no specific details about how this should be done or can be taught. In my personal opinion it is necessary for engineers to take a reflexive look at the assumptions of science that underlie their professional if not their personal life outlook. This is necessary so that they can also appreciate alternative outlooks as a basis for the inclusion of the social, cultural and political aspects that are more qualitative in their nature during engineering process.

In other words, whilst philosophy of science is not included in the guidelines it is a pre-requisite to the inclusion of social, cultural and political phenomena in engineering design and therefore is a relevant learning outcome for all engineers, not just those involved in international development and rural poverty reduction.

9.6 DISCUSSION

What has become apparent during the research for this chapter is that the skills required of engineers to effectively tackle issues of rural poverty in developing countries are in the majority already included as goals of mainstream engineering education. Those skills which are not covered, it has been argued, are equally as relevant to other types of engineering challenge as rural poverty reduction. Contrary to the initial hypothesis that informed the research, there is in actual fact no fundamental difference between the skills needed of engineers involved in rural poverty alleviation and those of other types of engineering.

Engineers who are adventurous enough to take on the challenge of tackling global poverty need to be as technically proficient as any other engineer. Whilst the technologies used in rural water and sanitation projects may differ from those commonly used in developed countries, the underlying scientific principles do not. The three core subjects required by the JBM of structures, materials and geotechnics are all essential learning for engineers working in developing countries.

The key difference between a student who wants to be involved in rural poverty alleviation and other students is only the type of project that the students are likely to be interested in. The JBM notes the importance of “realistic” case study projects during engineering education in Annex B, “These sorts of projects are characterised by extremely complex briefs full of diverse and often contradictory aspirations and well as numerous and often obscure constraints or opportunities relating to the site and the socio-economic context. The conception of plausible solutions is usually very demanding and complex. The tests required are similarly diverse and sometimes highly subjective and the judgements correspondingly challenging”.

Key motivating factors for students are often found in the design project work that they are involved in during their university studies (Newson and Delatte, 2011) and

the experience gained during these projects is often noted as beneficial in many ways by graduates (Isioglu and Kale, 2010). Case study projects of any nature can be created to combine technical, economic, social, management and sustainability issues and the topic probably does not matter much with regards to the skills learnt. The topic is likely to have a big impact on the interest and motivation of the students, however.

Providing students with the challenge of projects and coursework involving issues of poverty in developing countries could be a really exciting way of incorporating many of the key skills required by the JBM into mainstream engineering education. It could broaden the students' versatility as called for in Section 1 of the guidelines and provide the opportunity for students to develop their ability to produce imaginative and creative solutions to complex problems as called for in sections 1 and 3.12 respectively. As Sandy Cairncross points out, while many solutions to poverty reduction are low tech, cheap and simple, their implementation often requires a great degree of creativity (Cairncross in Guthrie et al. 2008).

9.7 CONCLUSIONS

There are no special skills that engineers need to be able to tackle issues of rural poverty in developing countries. Most of the skills are already included within the JBM guidelines as skills all engineers ought to be able to demonstrate on graduation from accredited university courses. Skills that are not included in the guidelines would benefit all engineers and not only those tackling rural poverty. Issues of poverty alleviation are mainstream engineering challenges that should receive attention during all university courses. It is suggested that the inclusion of case studies of an international development nature could be an exciting and engaging way of exposing student engineers to challenges that allow them to develop many of the skills they will need in their future careers, whether they go on to tackle rural poverty or not.

10 Conclusions

The general, overarching conclusion of this work is that the social and cultural context of rural water and sanitation projects in developing countries impacts on all aspects of engineering design and process, and failure to adapt engineering designs and processes appropriately for the local context may decrease the likelihood of the implemented systems being sustainable in the long term. This conclusion was arrived at following consideration of the conclusions of the previous four chapters, each which contemplated a different aspect of engineering design and process.

Chapter 5 focused on the design parameters of rural water and sanitation projects and concluded that design parameters can arise from the local socio-cultural context and consideration of these parameters during the design phase is likely to lead to systems which are more appropriate for the local context and may increase the chance of projects being sustainable in the long term.

Chapter 6 considered the engineering design process of rural water and sanitation projects and argued that community participation in design is crucial for a number of reasons, including as the means to identify the socio-cultural design parameters discussed in chapter 5. A general conclusion was reached that socio-cultural context is an important consideration if a range of different groups are to be reached and engaged in system design.

More specifically, chapter 6 concluded that participation is particularly difficult, and therefore requires more thought from engineers, in contexts where the local culture maintains large power distances between different groups of people. In this case considering group dynamic and particularly ‘who can speak’ during engagement activities is important. Where cultures are collectively, rather than individually, orientated it may be better to phrase questions about system design in terms of what

would be better for the group, as opposed to their individual feelings on what would be better. Authors such as Reed and Smout (2005) have already argued the connection between the success with which different groups within a community are reached and the likely sustainability of the final systems implemented.

Chapter 7 was the first of the two construction management chapters and reached the general conclusion that engineers need to adapt their project management processes to the local socio-cultural context, particularly with regards to the management structure employed. Socio-cultural context was also noted to have implications for quality control and construction sequencing. It was concluded that the 'village market' management structure often employed by British managers is not appropriate in every context, and suggested that Hofstede's analysis of different cultures and appropriate management styles might be a good starting point for engineers engaged in rural water and sanitation projects in developing countries.

Finally, chapter 8 looked more closely at health and safety management for projects which engage community members in construction work and concluded that there are particular challenges related to this type of project. It was found that the communal culture of the case study context resulted in community members feeling pressurised to undertake construction activities even when activities were perceived as dangerous. Local traditional laws were found to be the mechanism through which community members were obliged to take part in hazardous activities. Whilst the research was inconclusive about the boundaries within which these findings apply it is likely that there are implications for others managing community construction projects both in Ghana and further afield.

A key challenge of the research approach taken was finding ways to extrapolate the results from the specific contexts of the case study communities and infer implications of broader relevance for engineers working on other water and sanitation implementation projects in rural areas of developing countries. This

problem is symptomatic of the fact that the findings relate to socially constructed realities; unlike when universal truths are explored by scientific inquiry, it is not possible to assume that findings can be transferred to other projects in a straightforward way.

This perhaps begins to explain why finding solutions to the problem of how to deliver water and sanitation projects that are sustainable in the long term have so far proved illusive. Each project is unique and, as was noted by van Nieuwkoop and Uquillas (2000; see section 2.4.6), it is not possible to replicate what may have worked in one community in another without first examining the socio-cultural context specific to the new community and making the necessary adaptations.

It has been shown through this research how easy it is to be lured into a false sense of familiarity with a development context and miss a vital project consideration. This happened to the author at Baw, when she neglected to ask the community full details of the communal labour laws in place at the village (see section 7.4.2). She had begun to feel comfortable in the development context, having worked for a number of months in the region. A simple assumption, that as communal labour was carried out it would be enforced and everyone in the village would participate, based on an experience at a nearby village almost brought the project to a complete standstill.

There are many calls from the development literature for projects to be carried out on the very local level explored throughout this research. Mansuri and Rao (2004) refer to the need for each community to drive their own development and specify their own individual development priorities (section 2.4.3), Hobart (1992) talks of the need to consider local knowledges in development interventions (section 2.4.7), and Boserup (1970) calls for development interventions to consider how they affect different groups from within the beneficiary community (section 2.4.8). The findings of this research support the assertions of these authors of the need to

conduct projects at a very local level and also contribute to knowledge by increasing understanding of the relevance of these types of factors *for engineers* engaged in rural water and sanitation infrastructure provision.

Findings go some way to responding to Ali's (2009) assertion that, "there is increasing demand on engineering practice to understand and integrate the social dimension in to the planning, design and use of infrastructure" (see section 1.4 paragraph 2). Jowitt (2006) too called for increased understanding of, "the interactions between infrastructure and development, the environment, culture/society/community..." (see section 1.4 paragraph 3).

There are problems apparent in engineers taking this very local approach, however. This thesis began by acknowledging that globally, 1.1 billion people lack access to a clean source of drinking water; 2.6 billion lack access to basic sanitation facilities (UNDP, 2006). There simply are not enough engineers working in developing countries to provide this individual care and attention to every community which lacks access to water and sanitation systems across the developing world (see section 2.2).

Further research could usefully explore the implications of socio-cultural context for engineers engaged in water and sanitation projects in different contexts from the ones studied through this research. This could help identify further impacts, as well as test the boundaries of the influence of the social and cultural factors identified here. Having a more complete understanding of the range of influence of socio-cultural context on engineering work could provide guidance for engineers going into a new development context as to possible social and cultural dimensions of likely relevance and increase the chance of a successful project in a cost-effective and timely way.

Engineers have a crucial role to play in poverty reduction through the provision of water and sanitation facilities to the world's rural poor. Due to a lack of local engineers in developing countries support will be needed from abroad, at least in the short term. Currently far too many rural water and sanitation projects fail to be sustained in the long term. This has a devastating impact on the lives of people living in those communities and limits the opportunities available to them and their children. This research takes a first step towards finding locally adapted engineering solutions by exploring the implications of socio-cultural context during two case studies. The challenge remains of how to provide a truly localised service on the scale of the billions who lack access to these vital facilities.

Perhaps the answer lies in engineering education. What is needed might be an army of culturally attuned, socially astute (as well as technically proficient) engineers who are prepared to take on the challenge of providing the vital facilities required by the world's poor, which are needed if the world is to win the war against poverty. The next step for this research is to consider how engineering education might best be delivered to students within developing countries so that these nations can take charge of their own countries infrastructure development.

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Appendix A

ETHICAL STATEMENT

This research aims to carry out its work to the highest ethical and moral standards. The following values are integral to the ethical conduct of this research project.

Transparency, Honesty & Integrity

Transparency with communities involved in the research, as well as sponsors and all other stakeholders, is fundamental to the ethical management of this research. All parties must be clearly informed of the purposes and outcomes of the research. As the research is to be combined with a development project, the expectations of communities must be carefully managed to ensure they match realistic expected outcomes.

Competence

As a development project is to be undertaken as part of the research it is vital that all engineering work be carried out to the highest quality and that standards, particularly with regard to health and safety, are not reduced as the work is being undertaken outside the UK.

Cooperation & Inclusivity

The project is to be carried out with the cooperation of the local community, with full acknowledgement of their right to self-determination. Their views and requirements are to form a central component in engineering solution design. It is important that the project is inclusive and recognises the needs of all groups

affected by the project, including different ethnicities, ages, sexes and those of varying social standing.

Sustainability

Engineering work is to be carried out in a manner that is sustainable in the long term, with consideration of the needs of other communities affected by project work and future generations. Short term needs must be carefully balanced with long term sustainability.

Respect

The values can be summarised as having respect for everyone who is involved in the research and project. In particular it is important to respect the local Ghanaian people who are involved with this work, including their culture, their ways of life and right to privacy and dignity.

Non-Maleficence

Above all, the aim is to do no harm through this research and associated project.

Appendix B

SEMI-STRUCTURED INTERVIEW GUIDE QUESTIONS FOR CHAPTER 8

Were you worried that you would suffer any injuries whilst working on the construction project at your village?

Before starting any of the job activities did you think about how you might get hurt or how others might get hurt?

Can you think of an example of an activity during the project where you were worried someone might get hurt?

Yes - Did you participate in these activities?

If yes – why did you participate?

If no – why didn't you participate?

No – Can you say anything about why you weren't worried about injuries?

Did you do anything during the project to try to protect yourself from being injured?

What could you have done to prevent yourself from becoming hurt during the project?

What else could I have done to prevent you from becoming hurt during the work?

Religion Questions

Which of the following apply to you?

God (or the spirits or my ancestors) will decide whether I am safe or not so there is not a lot of point in wearing the safety hat and boots etc.

Even though God is taking care of me I have to use the PPE

It is me and/or my community who will keep me safe, not God.

Motivations

Why do you undertake labour for the community?

I have to it's the law

People will think badly of me if I don't

I want to improve my community

Other -

If you decide some work is too dangerous and do not do it what will other people in the community think of you?

If you refuse to do something because it is too dangerous will you get into trouble for breaking communal labour laws?

Are you more likely to do something risky if you think the work is very good/ needed for the community than if you do not think it is important?

Job Selection

Can you choose what job you do for communal labour?

(For example, when fixing a new roof who decides who will go up onto the roof and who will stay on the ground?)